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ABSTRACT

The National Science Foundation funded a project to: (1) identify major areas of science education research in which sufficient studies have been conducted to permit useful generalizations for educational practice; (2) conduct meta-analyses of each of these areas; and (3) prepare a compendium of these meta-analyses along with interpretative and integrative statements. This report is the second volume of the compendium, which includes three studies: "A Meta-Analysis of Research on Science Teacher Education Practices Associated with Inquiry Strategy" (Gary L. Sweitzer), "Science Teacher Characteristics by Teacher Behavior and by Student Outcome" (Cynthia Ann Druva), and "The Relationship of Student Characteristics and Student Performance in Science" (M. Lynette Fleming and Mark R. Malone). Table of contents, purpose, methodology, results, and conclusions are presented for each study. The last section includes a discussion directed at consolidating information on selected matters addressed in two or more of the separate meta-analyses and examining the relationship between results of these meta-analyses and other work of this nature conducted by other researchers. Coding forms and a complete bibliography of studies used and coded are provided in two extensive appendices. (Author/JN)

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A Meta-Analysis of Research on Science Teacher Education Practices Associated with Inquiry Strategy

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INTRODUCTION

The steering committee of the Colorado Science Meta-Analysis Project identified major questions for meta-analysis including the following: "What are the effects of different preservice and inservice science teacher training approaches?" The initial work on this particular meta-analysis question, however, indicated that the scope of it was beyond the resources available to address it; for example, 215 dissertations alone on this question between 1950 and 1977 were located. Thus, a rationale was sought for limiting the question.

This rationale was derived from the science course improvement projects of the sixties and seventies which sought to improve the science education of young people by placing a greater emphasis upon rationale thinking as a course outcome, using the discipline as a criterion for the selection of instructional materials, organizing the curriculum with both a concept and inquiry sequence, and shifting more responsibility for learning to the student. The essence of this curriculum reform mandated the teaching of science in an inquiry style of teaching that was investigative and student centered with inquiry skills as outcomes of instruction. This meta-analysis was limited to teacher education having as measured outcomes one or more variables associated with inquiry teaching.

Once the desired classroom behavior, an inquiry style of teaching, had been identified, the next step was determining teacher training procedures that could produce that behavior. A review of the training research by Balzer, Evans, and Blosser (1973) indicated the following:

1. An examination of 71 investigations revealed that providing teachers with training in systematic observation of classroom behavior was an effective means of changing teaching behavior. This was true of science education and non-science education investigations.
2. Twenty-nine studies of the influence of inservice training in one of the "New Science" programs on observed science classroom behavior were reviewed. A tally of the results revealed that inservice training in one or more of the course content improvement projects and/or use of the materials was a fairly effective way of influencing selected classroom behaviors.
3. Microteaching, either by itself or in combination with other instructional sequences, was reported to have been effective in changing selected aspects of classroom behavior in 7 of 10 studies. The specific behaviors or teaching skills generally were predetermined, operationally defined and practiced in a micro-teaching format.
4. Feedback following teaching was used in an attempt to alter classroom behavior in 38 investigations. Feedback was divided into four types: student data from systematic observation of classroom behavior, videotapes and/or audiotapes of classes, and supervisory conferences. The results showed that individually the subclasses of feedback were ineffective or inconsistent change agents, but that supervisory conference and videotaped feedback in combination brought about changes in selected aspects of classroom behavior. While this is only a sample of the research reviewed by Balzer, Evans, and Blosser, (1973) it would seem that techniques have been developed that accomplish teacher classroom behavior change.

It also has been claimed, however, that "There appears to be a discrepancy between existing general statements about the importance of inquiry and the attention given it in practice. Although teachers made positive statements about the value of inquiry, they often felt more responsibility for teaching facts, things which show up on tests, and structure of the work ethic. A major problem in promoting inquiry was encountered in the preparation of science teachers. Many teachers are ill-prepared, in their own eyes and in the eyes of others to guide students in inquiry learning and over one-third feel they receive inadequate support for such teaching." (Welch, Klopfer, Aikenhead, and Robinson, 1981) This discrepancy between educators' expectations for inquiry behavior and the actual status warranted a quantitative assessment of the existing research on training outcomes associated with teaching inquiry behaviors and the techniques and procedures used to obtain them.

Pursuing the topic of inquiry teaching poses problems of definition which must be addressed. The basis for a definition of inquiry strategy also should be set in historical perspective. While the curriculum reform movement of the sixties and seventies brought renewed consideration of inquiry strategy, Hurd (1969) indicated that it was given significant attention in major science education publications in previous decades from the 1930's on. It is not a new conceptualization.

Kyle (1980) addressed the semantics problem that arises in attempting to distinguish between inquiry in general and scientific inquiry and summarized several different activities and strategies associated with inquiry. He asserted that there was little agreement as to what constitutes scientific inquiry and indicated scientific inquiry should not be construed as synonymous with investigative, experimental or discovery methods of science teaching, self-instructional learning techniques, or open-ended learning techniques. Kyle stated "the ability to scientifically inquire is the personal, internalized ability of an individual to synthesize the knowledge which has been obtained through the learning of basic process skills and competencies, that enables a person to rationally inquire and solve problems by means of unrestrained inductive thinking."

Welch, et al.,(1981) offered further clarification on the semantics of inquiry, asserting "inquiry to be a general process by which human beings seek information or understanding. Broadly conceived, inquiry is a way of thought. Scientific inquiry, a subset of general inquiry, is concerned with the natural world and guided by certain beliefs and assumptions." They divided inquiry into three main themes: (1) general inquiry processes, (2) science process skills, and (3) nature of scientific inquiry. General inquiry processes include strategies such as problem-solving, use of evidence, logical and analytical reasoning, clarification of values, decision-making, and safeguards and customs of inquiry. Science process skills include the usual range of science processes, such as observing, measuring, interpreting data, etc. The nature of scientific inquiry is affected by the structure of scientific knowledge and by assumptions about the natural world such as causality and non-capriciousness.

Inquiry strategy within the context of this paper addresses those teacher behaviors that facilitate student acquisition of concepts, processes, and skills through active involvement with general inquiry strategies. It incorporates aspects of the investigative and discovery phases of science and affords opportunities for the students to test and refine concept meanings. Through this type of learning, and the acquisition and synthesis of scientific knowledge and processes, the ability to perform scientific inquiry becomes possible. A teacher equipped to engage in inquiry teaching would possess questioning skills that are divergent, have a knowledge of science processes and have the capacity to conduct student-centered inductive learning activities. Specific outcome criteria which appeared in the research reviewed for this analysis and judged as falling within the confines of this definition include the following: knowledge of science processes, inquiry instructional strategy, indirect verbal behavior, accepting interpersonal behaviors, increased wait-time questioning behavior, higher cognitive level questioning behavior, and discovery instructional strategy. This meta-analysis was limited to studies having at least one of these outcomes associated with inquiry strategy.

LOCATING AND CODING STUDIES

As indicated earlier, the extensiveness of the literature on science teacher education influenced the definition of the question addressed with this meta-analysis. These considerations also relate to the literature search process. First of all, because this meta-analysis was focused upon inquiry teaching, research dated between 1965 and 1980 was considered. This period parallels the implementation period for the modern science curriculum projects.

A second limitation was suggested by the work of Munby (1980). He concluded that "on the basis of his analysis there are grounds for viewing research on the affective outcomes of science education with misgiving, simply because there seems little to be said of the instruments as to enlist our confidence in their use." Furthermore, if we are attempting to change attitudes with an eye toward teacher practice, a review of research on changing the attitude of student eachers by Morrisey (1981) is relevant. He claimed that the lack of change in the teaching of elementary school science indicates something more than just immediate attitude change must be considered. Therefore, studies involving only affective outcomes were not included in the meta-analysis.

The literature search process began with dissertations. The Colorado staff reviewed the 3200 dissertation titles listed in the Science Education Dissertation Bibliography (1978) and identified dissertations related to in-service and pre-service teacher education.

Journal articles were identified applying the same criteria as for dissertations by scanning the table of contents of the Journal of Research in Science Teaching and Science Education for the years 1965 to 1980.

Research from sources other than dissertations and journals was identified through a search of the three ERIC compilations of abstracts from Resources in Education (1966-1972, 1973-1975, 1976-1977). Most of the materials identified in the compilations duplicated materials found elsewhere. The reasons for rejecting studies for the meta-analysis included the following: data needed for the calculation of effect size were incomplete, measured outcomes were only in the affective domain, the native language of the subjects was other than English, the study was produced prior to 1965, or the outcome variables were not associated with inquiry teaching strategy.

Relevant variables were identified and coded according to the following six major categories: study form and design characteristics, teacher/teacher trainee characteristics, student characteristics, treatment characteristics, outcome characteristics, and effect size calculation characteristics. These categories and six variables for the management of the data deck resulted in the delineation of 114 variables.

Effect size calculations were performed using the most straightforward method possible with the data presented in each study. The most straight forward method available and the one used in 64% of the effect size calculations involved standardization of the mean differences between treatment and control groups.

ANALYSIS OF DATA

Sixty-eight studies were coded resulting in 177 effect size calculations. OUtcomes were measured on teachers, on students, and on students about teachers. While many researchers advocate measuring teacher behavior by evaluating student performance, this practice occurred in a very small number of cases. One hundred and fifty-four effect sizes were outcomes measured on teachers, while only nineteen were outcomes measured on students and four were student measures about teachers. Because of the small sample size, no analysis of the effect sizes related to outcomes measured on teachers by students was performed.

While many advocate measuring teacher performance by measuring student outcomes, this practice occurred infrequently in this collection of studies on science teacher education. The nineteen effect sizes related to outcomes measured on students produced a mean effect size of .44 and a standard deviation of .67 when broken down across all variables. The mean reliability of the measurement instruments was .82 with a standard deviation of .06. The outcome most frequently measured (47% of the cases) was the knowledge of science processes.

The one hundred and fifty-four effect sizes related to outcomes on teachers produced a mean effect size of .85 with a standard deviation of 1.30 when broken down across all variables. One effect size determination was considered a far outlier, having a value three times greater than the next closest effect size and being approximately ten standard deviations above the mean. If this value is discarded the mean effect size across all variables becomes .77 with a standard deviation of .86.

The size of the teacher samples ranged from 9 to 299 with a mean of 60.4 and a standard deviation of 45.2. The number of teachers assigned to each treatment ranged from 5 to 129 with a mean of 26.8 and a standard deviation of 17.6. Test reliability was reported for fifty percent of the outcome measure instruments yielding a mean of .81 and a standard deviation of .09. Duration of treatment (with seven missing cases) ranged from less than a day to one year. The mean was 70.0 days with a standard deviation of 71.4.

Descriptive reporting of teacher and/or student characteristics which might affect outcome measures was sporadic and occurred with frequencies too low to support analysis. Therefore the analysis was divided into the following three major categories: (a) variables associated with methodological aspects of the studies, (b) variables associated with study treatments, and (c) variables associated with the variety of teacher education outcomes sought.

Teacher Outcomes - Methodological Variables

Table I presents the means, standard deviations, and sample sizes of selected methodological variables broken down across outcomes measured on teachers. Table II presents the Pearson correlation coefficients and significance level between selected methodological variables and between selected methodological variables and effect size. In situations where the variable categories did not reflect an ordinal relationship the categories were coded dichotomously for correlational purposes.

Table I presents nine methodological variables with the categories that had sufficient sample size to warrant discussion. The form of publication variable indicates the source of the information used for coding purposes. An attempt was made to locate the primary source whenever possible and if a study was presented as both a journal article and a dissertation, the dissertation was used as the source. The mean effect size calculated from journal articles was 1.01 while those calculated from dissertations was .59. There was a significant positive correlation ($p = 0.004$) between journals as a source and effect size and a significant negative correlation ($p = 0.05$) between dissertations as a source and effect size. These results indicate that a meta-analysis based solely on journals as a source has the potential of establishing effect size data higher than what might be expected if the extensive dissertation literature were used also.

The type of study variable was coded using the guidelines established by Campbell and Stanley (1963). Pre-experimental designs consisted of one-group pretest-post-test designs and static-groups comparison designs. Experimental designs involved pretest-posttest control groups designs and posttest-only control group designs with random assignment of subjects to treatment and control groups. Quasi-experimental designs involved the same designs as the experimental groups, but without random assignment of subjects. The mean effect size ranged from .90 for pre-experimental studies to .67 for experimental studies. The correlation coefficient was not significant at the .05 level.

The assignment of teachers to treatments was coded as random, matched, self-selected, intact groups, representative sample, and other. Random assignment and intact group assignment together accounted for 76% of the effect sizes produced. Random assignment studies had an average effect size of .67 and intact groups produced an effect size mean of .88.

The teacher unit of analysis variable indicated the unit (individual or group) that was used in establishing the degrees of freedom for the determination of significance level. The teacher unit of analysis used the number of individuals involved to determine degrees of freedom in 95% of the cases.

The internal validity variable addresses the assignment of individuals to treatments, and the percent mortality among treatment and control groups. Studies were rated high in internal validity if group equivalence was established through random assignment or other procedures and subject mortality was less than 15 percent. Studies were coded as medium if (a) randomization was not used but low mortality was maintained, (b) randomization existed but mortality was high or nonequivalent, and (c) if random procedures were used in the selection of intact groups and mortality was low. Studies were coded as low where intact convenience samples were used and/or where the existence of factors confounding the equivalence of the subject groups was apparent. Studies rated low in validity produced effect sizes with a mean of .55, medium validity studies produced effect sizes with a mean of .75, and high validity studies produced effect sizes with a mean of .82. The internal validity was positively correlated with effect size, but was not significant at the .05 level.

The design rating variable addressed the apparent degree of control of the confounding variables by the experimental procedure. Studies were rated as high if the design established control to the extent that post-treatment differences could be attributed to treatment effects. The study was rated as medium if the design indicated lack of control of a variable that probably contributed to some outcome differences. The study was rated as low if the failure to control a given variable obviously contributed to outcome differences. Studies with a low design rating had an average effect size of .80, medium studies had an average effect size of .61, and high studies had an average effect size of .99. A positive correlation coefficient with a significance level of .035 indicated that larger effect sizes were associated with higher design ratings.

The variable outcome instrument type, included instruments categorized as (a) published, (b) ad hoc developed for that particular study, or (c) other. Most of the tests in the other category were developed ad hoc for another study and then used in existing form or with modifications for the study being coded. The effect sizes that resulted from ad hoc instruments produced a mean effect size of 1.12. Other instruments produced an effect size of .60 and published instruments a mean of .35. The ad hoc instruments had a significant positive correlation with effect size (p 0.001) and the published and other categories had a significant negative correlation with effect size (p .05).

While these notably higher effect sizes for the specially designed instruments could be due to investigator bias, it seems more likely the result of the instruments being better designed to detect outcome differences to which the given study is directed.

Measurement method categories produced the following results for mean effect size: multiple choice .48, Likert .50, observation .84, and other 1.14. Multiple choice methods correlated negatively with effect size with a significance of .039. The "other" category correlated positively with effect size with a significance of .003. The remaining categories did not correlate significantly at the .05 level.

The time of measurement variable included the following categories: (a) after treatment, (b) pre-post, and (c) other. The latter category was used when different instruments on the same outcome were averaged to determine one effect size. The pre-post measurement produced the largest mean effect size, .90. The "other" category had a mean effect size of .74 and the after treatment category .62.

The number of teachers assigned to the study, the total number analyzed, and the number measured on each outcome instrument correlate negatively with effect size (significant at level of p .05). The journal category of the form of publication variable did not correlate significantly at the .05 level with any of the variables related to sample size, but the journal category did correlate significantly with the reported significance variable and the extent of treatment variable. The extent of treatment variable addressed the scope of the treatment with a multi-grade treatment, a program, or an on-going institute being at the broad end of the scale and a specific training technique being at the narrow end of the scale. These correlations indicated that studies taken from journals had low values for p and that these studies addressed treatment types of narrow scope.

Table III presents the average effect size, standard deviations and correlation coefficients for two of the variables related to effect size calculations: (a) source of means i.e., unadjusted posttest, pre-post difference or other and (b) method for calculation. Means for the calculation of effect size were unadjusted post-test means in 83 cases and provided a mean effect size of .62 with a standard deviation of .74. Means were a result of pre-post differences in 47 cases with a mean effect size of 1.00 and a standard deviation of 1.09. The "other" category involved pre-experimental studies wherein pre-test data was used to generate a control group mean. This category provided a mean effect size of .88 and a standard deviation of .75. The unadjusted post-test source of means had a negative correlation with effect size significant at the .05 level. The source of means in the pre-post category had a positive correlation with effect size significant at the .05 level also.

The methods used for calculating the effect size included the following: (a) calculating directly from reported means and variances or from raw data, (b) calculating with direct estimates of the variance from ANOVA, t, and F values, (c) calculating using reported probability levels, and (d) calculating using pre-test data as a control group. Using pre-test data as a control group produced the highest mean effect size 1.01 with a standard deviation of .78. The means and standard deviations for using directly reported means and variances and direct estimates were close, having mean effect values of .72 and .84 respectively. None of the calculation method variables showed a significant correlation with effect size at the .05 level.

Teacher Outcomes - Treatment Variables

Tables IV and V present the effect sizes of teacher outcomes broken down across various treatment variables and Table VI presents correlations between treatment variables and effect size. The first of these variables, time of treatment, was categorized as pre-service and in-service and these two groups produced mean effect sizes of .78 and .72 respectively.

The site of treatment variable categorized field-based treatments versus university based treatments. The field-based treatments category was further divided into treatments that occurred in the schools in which the teachers were employed versus treatments in schools where the individuals were not employed. Treatments were predominately university-based accounting for 77% of the reported effect sizes. The mean effect sizes for the three groups were very close in value ranging from .74 to .77.

The extent of treatment variable ranged from a broad scope addressing multi-grade or program treatments to treatments that focused on a particular training technique. The multi-grade or program level produced a mean effect size of .45, the one grade or level variable produced a mean effect size of .75, and the training technique level produced a mean effect size of .84.

The "treatment geared to grade level" variable categorized the target population where the treatment outcomes were to be applied. The elementary level group accounted for 81% of the effect sizes coded and produced a mean effect size of .76 with a standard deviation of .86. Those treatments categorized as secondary had a mean effect size of .39 and those categorized as general had a value of 1.24.

In many instances more than one treatment variable was used to classify a treatment. Those treatments that were described using one variable produced a mean effect size of .67, two variables .89, three variables .73, and four variables 1.25. A positive correlation between this variable and effect size occurred at a probability level .001.

Of the many treatment variables, those designated here as "treatment type" are of particular interest. The data on these variables is found in Table V; this Table, in contrast to the previous Tables, includes all variables regardless of the number of effect sizes recorded.

Treatment type variables were divided into the following sections: organizational pattern, type of instruction, mode of instruction, source of structure, locus of control, training techniques and technology employed.

The first of these categories refers to the form of organizational pattern within which the instruction was offered. The next five all refer to the type of instruction offered.

Some treatments were categorized in terms of the treatment organizational pattern and included the following: field-based programs, workshops, methods courses, science courses designed for teachers, and units of study. Those variables with an N of more than three included the field-based program category with a mean effect size of .35, the workshop level at .73, methods courses at .79, science courses designed for teachers at .97, and specific units of study at 1.38.

The type of instruction category pertains to the instructional approach used in the teacher education activities. If the treatment involved instruction versus no instruction with no further delineation of approach it was categorized as general. Other appraoches were termed traditional, inquiry, and discovery. The classification as inquiry or discovery was made from the language used in the study coded even though the terms were considered as synonymous in this report. The general instructional category produced a mean effect size of .79, traditional instruction had an effect size of .30, the inquiry category had a mean effect size of .63 and the discovery appraoch had an N of .40.

The mode of instruction categorized the approaches as predominately verbal, predominately concrete indicating a high level of student involvement with manipulative exercises, or mixed involving both the verbal and the concrete. Little data was found in the verbal category but the concrete mode produced a mean effect size of .75 and the mixed mode produced a mean effect size of .44.

The source of structure concept addresses the source of instructional objectives, content, and/or method used in the treatment.

The categories include student self-directed, student interacting with materials/and or the teacher, the teacher as the source of structure, and criterion referenced sources. The source of structure involving student self-direction produced a very low average effect size, .04. The structure that involved interaction of the student with materials and/or the teacher produced a mean effect size of .70. A similar effect size (.69) was found for "criterion referenced," although this result is based on only two studies.

The locus of control concept addresses the approach used in meeting the objectives, etc., set forth in the structure component. The categories included student self-directed, student and teacher working together, teacher directed, and a mix of part student and part teacher directed. The student self-directed category produced a mean effect size of .81, based on 44 effect sizes. Though a higher value is reported for "teacher directed," it is based on only one study.

The training technique concept addressed educational practices usually employed within the confines of a course or workshop. This concept included the following categories: interaction analysis feedback, instructional strategy feedback, wait-time analysis, questioning analysis, micro-teaching peers, micro-teaching students, modeling strategy, and behavior coding training or strategy analysis. Instructional strategy feedback produced a mean effect size of .67, modeling strategy 1.56, micro-teaching peers .72, micro-teaching students .81, behavior coding training analysis 1.37, and questioning analysis 1.38.

The technology concept addresses the use of audio technology, video technology, programmed material or auto-tutorial methods as treatment variables. Treatments using audio technology had a mean effect size of .99.

Teacher Outcomes - by Outcome Category

Outcome criteria were classified into the following three categories: criteria related to knowledge and intellectual processes, criteria related to classroom teacher behaviors, and criteria related to affective outcomes. Information on teacher outcome effect sizes by type of outcome is found in Table VII.

In the knowledge and intellectual processes category, knowledge of science processes was by far the most commonly measured. It was measured in 33 cases and produced a mean effect size of 1.08. Other outcome variables were measured much less frequently as shown in Table VII. The knowledge and intellectual processes category overall produced an average effect size of .80 based on 55 effect sizes.

The measurement of outcome variables in the teacher classroom behavior category was more varied with six different variables being measured in four or more studies. The variable inquiry strategy had a mean effect size of .89, indirect verbal behavior .72, interpersonal behaviors .54, questioning-level .72, discovery strategy .70, and questions (process directed) 1.45. The teacher classroom behavior category overall produced a mean effect size of .82 based on 60 effect sizes.

A variety of affective measures were used in these teacher education studies including measures of attitudes toward science, science teaching, and several others. The average effect size in these categories varied from .09 to .79 with a mean overall effect size for the affective category of .47 based on 31 effect sizes.

Further Information

A more complete record of the data acquired is presented in Tables 8 through 59.

Table I
Teacher Outcome Effect Sizes
Across Study Methodological Variables

Variable	Mean Effect Size	Standard Deviation	N
Form of publication			
Journal	1.01	.98	61
Dissertation	.59	.77	85
Other	.75	.24	7
Type of study			
Pre-experimental	.90	.73	22
Quasi-experimental	.78	.83	69
Experimental	.67	.92	60
Assignment of teachers to treatments			
Random	.67	.91	61
Self-selected	.57	.78	17
Intact groups	.88	.86	56
Teacher unit of analysis			
Individual	.77	.88	145
Classroom or group	.75	1.00	4
Rated internal validity			
Low	.55	.55	25
Medium	.75	.82	55
High	.82	.98	68
Design Rating			
Low	.57	.80	41
Medium	.68	.61	38
High	.92	.99	72
Outcome instrument type			
Published, national stand.	.35	.58	16
Ad hoc, for that study	1.12	.94	59
Other	.60	.76	77
Measurement method			
Multiple choice	.48	.61	31
Likert	.50	.44	24
Observation	.84	.93	49
Other	1.14	1.07	35
Time of measurement			
After treatment	.62	.76	60
Pre-post	.90	.96	80
Other	.74	.59	9

Table II

Correlations Among Selected Methodological Variables and Between Methodological Variables and Effect Size

Variable A	Variable B	r	p	N
Form of pub. journal	effect size	0.23	0.004	61
Form of pub. journal	extent of treat	0.21	0.008	61
Form of pub. journal	# of teachers assigned	-0.04	0.634	61
Form of pub. journal	# of teachers analyzed	-0.00	0.959	61
Form of pub. journal	reported sig.	-0.22	0.010	61
Type of study	effect size	-0.09	0.248	151
Rated internal validity	effect size	0.10	0.214	148
Design rating	effect size	0.17	0.035	151
Outcome instrument, pub. national standardized	effect size	-0.17	0.039	16
Outcome instrument. ad hoc	effect size	0.32	0.000	59
Outcome instru. other	effect size	-0.20	0.012	77
Measurement method multiple choice	effect size	-0.17	0.039	31
Measurement method other	effect size	0.24	0.003	35
# of teachers assigned	effect size	-0.21	0.011	152
# of teacher analyzed	effect size	-0.17	0.031	153
# of teachers on outcome measure	effect size	-0.17	0.035	149

Table III

Teacher Outcome Effect Sizes Across Effect Size Calculation Variables

Variable	Mean Effect Size	Standard Deviation	N
Source of means unadjusted post-test	.62	.74	83
Source of means pre-post differences	1.00	1.09	47
Source of means other	.88	.75	19
Calculated directly from reported values or raw data	.72	.90	96
Calculated with direct estimates (ANOVA, t,F)	.84	.87	34
Calculated from reported probability levels	.71	.15	5
Calculated using pre-test data as a control group	1.02	.78	15

Correlation with Effect Size

Variable	r	p	N
Source of means unadjusted post-test	-0.1865	0.021	83
Source of means pre-post dif.	0.1745	0.031	19
Calculated directly from reported values or raw data	-0.0694	0.394	96
Calculated with direct estimates (ANOVA, t,F)	0.0420	0.606	34
Calculated from reported probability levels	-0.0131	0.872	5
Calculated using pre-test data as a control group	0.0948	0.244	15

Table IV

Teacher Outcome Effect Sizes Across Treatment Variables (Part I)

Variable	Mean Effect Size	Standard Deviation	N
Time of treatment			
Pre-service	.78	.90	122
In-service	.72	.74	31
Site of treatment			
Field-based, site of employment	.74	.86	5
Field-based, not the site of employment	.77	.60	20
University-based	.77	.88	112
Extent of treatment			
Multi-grade or level, e.g., program or ongoing institute	.45	.45	12
One grade or level, e.g., course or workshop	.75	.78	69
Training technique	.84	.98	72
Treatment geared to grade level			
Elementary school	.76	.86	123
Secondary	.39	.32	8
General	1.24	.97	15
Number of variables used to describe each treatment			
1	.67	.57	42
2	.65	.89	64
3	.73	.62	31
4	1.25	1.03	14

Table V
Teacher Outcome Effect Sizes Across Treatment Variables (Part II)

Treatment Type		$\bar{\Delta}$	s	n
Organizational Pattern	Field-based Program	.35	.40	8
	Ongoing Institute	.64	.94	2
	Summer Institute	.14	.09	3
	Workshop	.73	.75	16
	Methods Course	.79	.94	22
	Science Course	1.28	.48	2
	Science Course Designed for Teachers	.97	.70	9
	Units of Study	1.38	1.29	22
Type of Instruction	General	.79	1.21	35
	Traditional	.30	.32	5
	Inquiry	.63	.63	9
	Discovery	.40	.29	7
Mode of Instruction	Verbal	-.03	.18	2
	Mixed	.45	.86	12
	Concrete	.75	.75	20
Source of Structure	Student Self-Directed	.04	.46	8
	Student interacting with teacher and/or Materials	.70	1.01	8
	Teacher	--	--	0
	Criterion referenced	.69	.02	2
Focus of Control	Student self-directed	.82	.88	44
	Teacher directed	1.44	0	1
	Mix, part student, part teacher	--	--	0
Training Technique	Interaction Analysis Feedback	1.33	0	1
	Instructional Strategy Feedback	.67	.91	10
	Wait-Time Analysis	3.95	.07	2
	Questioning Analysis	1.38	1.65	8
	Micro-teaching Peers	.72	.35	4
	Micro-teaching Students	.81	.52	6
	Modeling Strategy	1.56	1.19	14
	Behavior Coding Training (e.g. IA) or Strategy Analysis	1.37	.87	8
Technology Employed	Audio Technology	1.04	.25	4
	Video Technology	1.82	1.44	9
	Programmed Material (Audio-Tutorial)	.99	.76	17
	Print Material	1.40	0	1

Table VI

Correlations Between Selected Treatment Variables and Effect Size

Variable	r	p	N
# of variables describing treatment	0.3123	0.000	153
treatment units of study	0.2884	0.000	22
source of structure student self-directed	-0.2003	0.013	8
questioning analysis	0.1664	0.040	8
modeling strategy	0.2928	0.000	14
behavior coding training or strategy analysis	0.1637	0.043	8
video technology	0.3039	0.000	9
outcome science processes	0.1871	0.021	33
outcome questions process directed	0.1962	0.015	9

Table VII

Teacher Outcome Effect Sizes by Type of Outcome

Type of Outcome		$\bar{\Delta}$	s	n
Knowledge and Intellectual Processes	Science Content	.52	.79	7
	Science Processes	1.08	1.03	33
	Methods of Science and the scientific enterprise	.14	.74	3
	Critical Thinking	.09	0	1
	Creativity	.19	0	1
	Problem Solving	.04	.23	5
	Behavioral Objectives	.75	.14	3
	Planning (organizational skill)	.90	.12	2
	Composite Knowledge and Intellect	.80		55
Teacher Classroom Behaviors	Verbal Behavior, General	.15	0	1
	Inquiry Strategy	.89	.47	4
	Concrete Manipulative Strategy	1.26	0	1
	Indirect Verbal Behavior	.72	.82	18
	Interpersonal Behaviors	.54	.26	5
	Questioning-level	.72	1.18	13
	Discovery Strategy (Student Centered, open)	.70	.53	7
	Group Process Skills	.26	0	1
	Questions - Process Directed	1.45	.60	9
	Reactions to Classroom Situations	.84	0	1
	Composite Teacher Classroom Behaviors	.82		60
Affective	Attitude (general)	.79	.56	6
	Attitude toward Science	.39	.29	10
	Attitude toward Science Teaching	.09	.21	4
	Attitude toward Treatment	.46	0	1
	Dogmatism (toward open)	.34	.34	5
	Philosophy of Teaching (toward student centered)	.72	.65	4
	Attitude toward Treatment Emphasis	.60	0	1
	Composite Affective	.47		31

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Table 8
Frequencies of Selected Variables
Associated with Outcomes Measured on Students

STUDY

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
5001.	4	21.1	21.1
5701.	1	5.3	5.3
5703.	4	21.1	21.1
5707.	2	10.5	10.5
5713.	4	21.1	21.1
5714.	1	5.3	5.3
5716.	3	15.8	15.8
TOTAL	19	100.0	100.0

TYPE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	5	26.3	26.3
3.	11	57.9	57.9
4.	3	15.8	15.8
TOTAL	19	100.0	100.0

FORM

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	4	21.1	21.1
4.	15	78.9	78.9
TOTAL	19	100.0	100.0

ASSIGN

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	11	57.9	57.9
3.	1	5.3	5.3
6.	7	36.8	36.8
TOTAL	19	100.0	100.0

Table 8 (cont'd)

ANAL

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
18.	4	21.1	21.1
29.	1	5.3	5.3
30.	5	26.3	26.3
47.	3	15.8	15.8
48.	6	31.6	31.6
TOTAL	19	100.0	100.0

SUNIT

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	12	63.2	63.2
2.	4	21.1	21.1
4.	3	15.8	15.8
TOTAL	19	100.0	100.0

VALID

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	4	21.1	21.1
2.	4	21.1	21.1
3.	11	57.9	57.9
TOTAL	19	100.0	100.0

RATE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	4	21.1	21.1
2.	4	21.1	21.1
3.	11	57.9	57.9
TOTAL	19	100.0	100.0

Table 8 (cont'd)

STUSAMP

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
120.	2	10.5	13.3
184.	6	31.6	40.0
292.	4	21.1	26.7
300.	3	15.8	20.0
9999.	4	21.1	MISSING
TOTAL	19	100.0	100.0

STUFEMAL

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
56.	2	10.5	100.0
9999.	17	89.5	MISSING
TOTAL	19	100.0	100.0

STULEVEL

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	1	5.3	6.7
4.	6	31.6	40.0
5.	5	26.3	33.3
6.	3	15.8	20.0
9999.	4	21.1	MISSING
TOTAL	19	100.0	100.0

MIN

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	5.3	33.3
5.	2	10.5	66.7
9999.	16	84.2	MISSING
TOTAL	19	100.0	100.0

Table 8 (cont'd)

```
NTREAT1

                               RELATIVE   ADJUSTED
                   ABSOLUTE      FREQ       FREQ
          CODE       FREQ       (PCT)      (PCT)

            9.          4        21.1       21.1
           10.          4        21.1       21.1
           15.          1         5.3        5.3
           16.          3        15.8       15.8
           17.          3        15.8       15.8
           23.          1         5.3        5.3
           50.          3        15.8       15.8
                   ------      ------     ------
         TOTAL         19       100.0      100.0

SPONS1

                               RELATIVE   ADJUSTED
                   ABSOLUTE      FREQ       FREQ
          CODE       FREQ       (PCT)      (PCT)

            2.          7        36.8       87.5
            3.          1         5.3       12.5
         9999.         11        57.9     MISSING
                   ------      ------     ------
         TOTAL         19       100.0      100.0

TIME1

                               RELATIVE   ADJUSTED
                   ABSOLUTE      FREQ       FREQ
          CODE       FREQ       (PCT)      (PCT)

            1.         11        57.9       57.9
            2.          8        42.1       42.1
                   ------      ------     ------
         TOTAL         19       100.0      100.0

SITTRET1

                               RELATIVE   ADJUSTED
                   ABSOLUTE      FREQ       FREQ
          CODE       FREQ       (PCT)      (PCT)

            1.          4        21.1       21.1
            2.          3        15.8       15.8
            3.          8        42.1       42.1
            4.          4        21.1       21.1
                   ------      ------     ------
         TOTAL         19       100.0      100.0
```

Table 8 (cont'd)

EXTTRET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	4	21.1	21.1
2.	8	42.1	42.1
3.	7	36.8	36.8
TOTAL	19	100.0	100.0

LEUTRET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	15	78.9	78.9
5.	4	21.1	21.1
TOTAL	19	100.0	100.0

CONTEX11

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
5.	4	21.1	36.4
8.	1	5.3	9.1
13.	4	21.1	36.4
23.	2	10.5	18.2
9999.	8	42.1	MISSING
TOTAL	19	100.0	100.0

CONTEX12

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
13.	2	10.5	28.6
14.	4	21.1	57.1
23.	1	5.3	14.3
9999.	12	63.2	MISSING
TOTAL	19	100.0	100.0

Table 8. (cont'd)

TRTY101

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
3.	4	21.1	33.3
5.	4	21.1	33.3
6.	4	21.1	33.3
9999.	7	36.8	MISSING
TOTAL	19	100.0	100.0

TRTY103

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
13.	2	10.5	50.0
15.	2	10.5	50.0
9999.	15	78.9	MISSING
TOTAL	19	100.0	100.0

TRTY107

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
29.	2	10.5	100.0
9999.	17	89.5	MISSING
TOTAL	19	100.0	100.0

TRTY108

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
34.	1	5.3	14.3
39.	6	31.6	85.7
9999.	12	63.2	MISSING
TOTAL	19	100.0	100.0

Table 8 (cont'd)

TRTY110

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
41.	3	15.8	50.0
42.	3	15.8	50.0
9999.	13	68.4	MISSING
TOTAL	19	100.0	100.0

TREM101

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	5	26.3	26.3
19.	5	26.3	26.3
29.	4	21.1	21.1
35.	1	5.3	5.3
51.	4	21.1	21.1
TOTAL	19	100.0	100.0

TREM102

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
19.	4	21.1	57.1
40.	1	5.3	14.3
51.	2	10.5	28.6
9999.	12	63.2	MISSING
TOTAL	19	100.0	100.0

TREM103

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
19.	1	5.3	100.0
9999.	18	94.7	MISSING
TOTAL	19	100.0	100.0

Table 8 (cont'd)

DUR1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	6	31.6	31.6
5.	2	10.5	10.5
16.	1	5.3	5.3
35.	1	5.3	5.3
70.	2	10.5	10.5
112.	3	15.8	15.8
270.	4	21.1	21.1
TOTAL	19	100.0	100.0

CONTACT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	6	31.6	50.0
4.	1	5.3	8.3
30.	4	21.1	33.3
72.	1	5.3	8.3
9999.	7	36.8	MISSING
TOTAL	19	100.0	100.0

NOUT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
94.	1	5.3	5.6
144.	4	21.1	22.2
184.	2	10.5	11.1
288.	2	10.5	11.1
290.	2	10.5	11.1
300.	3	15.8	16.7
348.	2	10.5	11.1
398.	2	10.5	11.1
9999.	1	5.3	MISSING
TOTAL	19	100.0	100.0

Table .8(cont'd)

CRIOUT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	5.3	5.3
2.	9	47.4	47.4
9.	1	5.3	5.3
14.	3	15.8	15.8
27.	1	5.3	5.3
28.	3	15.8	15.8
29.	1	5.3	5.3
TOTAL	19	100.0	100.0

MEATYP1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	5	26.3	26.3
2.	7	36.8	36.8
5.	7	36.8	36.8
TOTAL	19	100.0	100.0

INTENT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	17	89.5	89.5
2.	2	10.5	10.5
TOTAL	19	100.0	100.0

MSMET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	8	42.1	42.1
3.	6	31.6	31.6
4.	2	10.5	10.5
8.	3	15.8	15.8
TOTAL	19	100.0	100.0

Table 8 (cont'd)

VALEST1

```
                           RELATIVE   ADJUSTED
             ABSOLUTE        FREQ       FREQ
   CODE        FREQ         (PCT)      (PCT)

     1.           6          31.6      100.0

  9999.          13          68.4     MISSING
              -----        ------     ------
  TOTAL          19         100.0      100.0
```

TMMEA1

```
                           RELATIVE   ADJUSTED
             ABSOLUTE        FREQ       FREQ
   CODE        FREQ         (PCT)      (PCT)

     2.          11          57.9       57.9

     3.           8          42.1       42.1
              -----        ------     ------
  TOTAL          19         100.0      100.0
```

PREPOS1

```
                           RELATIVE   ADJUSTED
             ABSOLUTE        FREQ       FREQ
   CODE        FREQ         (PCT)      (PCT)

     1.           8          42.1      100.0

  9999.          11          57.9     MISSING
              -----        ------     ------
  TOTAL          19         100.0      100.0
```

REACT1

```
                           RELATIVE   ADJUSTED
             ABSOLUTE        FREQ       FREQ
   CODE        FREQ         (PCT)      (PCT)

     1.           5          26.3       26.3

     2.           2          10.5       10.5

     3.          12          63.2       63.2
              -----        ------     ------
  TOTAL          19         100.0      100.0
```

Table 8 (cont'd)

FORREL1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	5.3	11.1
2.	3	15.8	33.3
3.	4	21.1	44.4
6.	1	5.3	11.1
9999.	10	52.6	MISSING
TOTAL	19	100.0	100.0

CALC01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	15	78.9	83.3
2.	3	15.8	16.7
9999.	1	5.3	MISSING
TOTAL	19	100.0	100.0

INST01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	16	84.2	88.9
2.	1	5.3	5.6
3.	1	5.3	5.6
9999.	1	5.3	MISSING
TOTAL	19	100.0	100.0

MEANS01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	11	57.9	57.9
4.	7	36.8	36.8
5.	1	5.3	5.3
TOTAL	19	100.0	100.0

Table 8 (cont'd)

SIG01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	5.3	5.6
2.	3	15.8	16.7
3.	6	31.6	33.3
5.	8	42.1	44.4
9999.	1	5.3	MISSING
TOTAL	19	100.0	100.0

COUNTRE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	9	47.4	47.4
2.	8	42.1	42.1
3.	2	10.5	10.5
TOTAL	19	100.0	100.0

Table 9
Frequencies of Selected Variables
Associated with Outcomes Measured on Teachers

FORM

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	62	40.3	40.3
3.	1	0.6	0.6
4.	84	54.5	54.5
5.	7	4.5	4.5
TOTAL	154	100.0	100.0

TYPE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	69	44.8	45.4
3.	60	39.0	39.5
4.	23	14.9	15.1
9999.	2	1.3	MISSING
TOTAL	154	100.0	100.0

ASSIGN

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	61	39.6	40.7
2.	1	0.6	0.7
3.	18	11.7	12.0
4.	56	36.4	37.3
6.	14	9.1	9.3
9999.	4	2.6	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TUNIT

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	145	94.2	97.3
2.	4	2.6	2.7
9999.	5	3.2	MISSING
TOTAL	154	100.0	100.0

TCOR

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	68	44.2	48.2
2.	73	47.4	51.8
9999.	13	8.4	MISSING
TOTAL	154	100.0	100.0

VALID

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	26	16.9	17.6
2.	54	35.1	36.5
3.	68	44.2	45.9
9999.	6	3.9	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

RATE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	42	27.3	27.6
2.	38	24.7	25.0
3.	72	46.8	47.4
9999.	2	1.3	MISSING
TOTAL	154	100.0	100.0

CHAR

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	2	1.3	1.3
2.	149	96.8	97.4
3.	2	1.3	1.3
9999.	1	0.6	MISSING
TOTAL	154	100.0	100.0

FEMALE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
17.	3	1.9	8.3
54.	1	0.6	2.8
73.	1	0.6	2.8
78.	4	2.6	11.1
80.	2	1.3	5.6
88.	6	3.9	16.7
91.	6	3.9	16.7
95.	8	5.2	22.2
100.	5	3.2	13.9
9999.	118	76.6	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

EDUBACK

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	115	74.7	81.6
2.	17	11.0	12.1
3.	8	5.2	5.7
5.	1	0.6	0.7
9999.	13	8.4	MISSING
TOTAL	154	100.0	100.0

MAJOR

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	0.6	2.9
8.	12	7.8	35.3
10.	11	7.1	32.4
11.	10	6.5	29.4
9999.	120	77.9	MISSING
TOTAL	154	100.0	100.0

LEVEL

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	8	5.2	14.3
3.	12	7.8	21.4
4.	14	9.1	25.0
5.	6	3.9	10.7
6.	16	10.4	28.6
9999.	98	63.6	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

EXPT

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
0.	118	76.6	86.8
5.	1	0.6	0.7
7.	7	4.5	5.1
9.	3	1.9	2.2
10.	2	1.3	1.5
11.	2	1.3	1.5
15.	3	1.9	2.2
9999.	18	11.7	MISSING
TOTAL	154	100.0	100.0

TIME1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	122	79.2	79.2
2.	32	20.8	20.8
TOTAL	154	100.0	100.0

SITTRET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	5	3.2	3.4
2.	20	13.0	13.7
3.	112	72.7	76.7
4.	9	5.8	6.2
9999.	8	5.2	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	12	7.8	7.8
2.	70	45.5	45.5
3.	72	46.8	46.8
TOTAL	154	100.0	100.0

LEUTRET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	123	79.9	80.4
3.	2	1.3	1.3
4.	2	1.3	1.3
5.	3	1.9	2.0
6.	15	9.7	9.8
8.	8	5.2	5.2
9999.	1	0.6	MISSING
TOTAL	154	100.0	100.0

CONTEX11

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	2	1.3	2.1
5.	2	1.3	2.1
7.	1	0.6	1.1
8.	61	39.6	64.2
9.	2	1.3	2.1
10.	5	3.2	5.3
12.	12	7.8	12.6
13.	4	2.6	4.2
16.	1	0.6	1.1
21.	1	0.6	1.1
23.	4	2.6	4.2
9999.	59	38.3	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

CONTEX12

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
8.	3	1.9	16.7
12.	1	0.6	5.6
13.	4	2.6	22.2
14.	1	0.6	5.6
22.	3	1.9	16.7
23.	5	3.2	27.8
24.	1	0.6	5.6
9999.	136	88.3	MISSING
TOTAL	154	100.0	100.0

TRTY101

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	8	5.2	9.6
3.	2	1.3	2.4
4.	3	1.9	3.6
5.	17	11.0	20.5
6.	22	14.3	26.5
7.	2	1.3	2.4
8.	9	5.8	10.8
10.	20	13.0	24.1
9999.	71	46.1	MISSING
TOTAL	154	100.0	100.0

TRTY102

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
10.	2	1.3	100.0
9999.	152	98.7	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TRTY103

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
12.	35	22.7	62.5
13.	5	3.2	8.9
14.	9	5.8	16.1
15.	7	4.5	12.5
9999.	98	63.6	MISSING
TOTAL	154	100.0	100.0

TRTY104

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
17.	2	1.3	6.5
18.	12	7.8	38.7
19.	17	11.0	54.8
9999.	123	79.9	MISSING
TOTAL	154	100.0	100.0

TRTY105

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
19.	3	1.9	75.0
26.	1	0.6	25.0
9999.	150	97.4	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TRTY106

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
25.	8	5.2	34.8
26.	7	4.5	30.4
28.	2	1.3	8.7
29.	6	3.9	26.1
9999.	131	85.1	MISSING
TOTAL	154	100.0	100.0

TRTY107

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
29.	38	24.7	90.5
31.	1	0.6	2.4
34.	1	0.6	2.4
35.	2	1.3	4.8
9999.	112	72.7	MISSING
TOTAL	154	100.0	100.0

TRTY108

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
33.	1	0.6	2.1
34.	7	4.5	14.6
36.	8	5.2	16.7
37.	1	0.6	2.1
38.	6	3.9	12.5
39.	12	7.8	25.0
40.	7	4.5	14.6
57.	2	1.3	4.2
58.	4	2.6	8.3
9999.	106	68.8	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TRTY109

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
34.	2	1.3	16.7
37.	3	1.9	25.0
39.	2	1.3	16.7
40.	1	0.6	8.3
57.	4	2.6	33.3
9999.	142	92.2	MISSING
TOTAL	154	100.0	100.0

TRTY110

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
41.	4	2.6	12.9
42.	9	5.8	29.0
44.	17	11.0	54.8
45.	1	0.6	3.2
9999.	123	79.9	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TREM101

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	10	6.5	6.5
2.	60	39.0	39.0
3.	9	5.8	5.8
4.	1	0.6	0.6
8.	1	0.6	0.6
18.	3	1.9	1.9
19.	10	6.5	6.5
20.	3	1.9	1.9
21.	4	2.6	2.6
24.	10	6.5	6.5
26.	1	0.6	0.6
29.	10	6.5	6.5
35.	14	9.1	9.1
36.	4	2.6	2.6
42.	2	1.3	1.3
50.	5	3.2	3.2
51.	7	4.5	4.5
TOTAL	154	100.0	100.0

Table 9 (cont'd)

TREM102

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	3	1.9	4.4
2.	9	5.8	13.2
7.	2	1.3	2.9
19.	8	5.2	11.8
22.	2	1.3	2.9
23.	2	1.3	2.9
24.	1	0.6	1.5
28.	2	1.3	2.9
32.	2	1.3	2.9
34.	3	1.9	4.4
35.	10	6.5	14.7
36.	5	3.2	7.4
38.	2	1.3	2.9
39.	3	1.9	4.4
40.	4	2.6	5.9
41.	4	2.6	5.9
51.	4	2.6	5.9
55.	2	1.3	2.9
9999.	86	55.8	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	2	1.3	4.9
4.	4	2.6	9.8
7.	1	0.6	2.4
8.	2	1.3	4.9
19.	4	2.6	9.8
20.	3	1.9	7.3
24.	2	1.3	4.9
26.	1	0.6	2.4
28.	3	1.9	7.3
35.	1	0.6	2.4
36.	6	3.9	14.6
38.	2	1.3	4.9
40.	5	3.2	12.2
41.	1	0.6	2.4
44.	1	0.6	2.4
45.	1	0.6	2.4
50.	2	1.3	4.9
9999.	113	73.4	MISSING
TOTAL	154	100.0	100.0

TREM104

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	1	0.6	5.6
14.	2	1.3	11.1
15.	1	0.6	5.6
19.	1	0.6	5.6
21.	1	0.6	5.6
32.	2	1.3	11.1
35.	4	2.6	22.2
41.	4	2.6	22.2
43.	1	0.6	5.6
50.	1	0.6	5.6
9999.	136	88.3	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

DUR1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
0.	2	1.3	1.4
1.	21	13.6	14.3
3.	3	1.9	2.0
4.	1	0.6	0.7
5.	5	3.2	3.4
7.	4	2.6	2.7
10.	1	0.6	0.7
11.	1	0.6	0.7
14.	1	0.6	0.7
16.	4	2.6	2.7
20.	1	0.6	0.7
21.	1	0.6	0.7
31.	1	0.6	0.7
35.	6	3.9	4.1
42.	16	10.4	10.9
56.	1	0.6	0.7
63.	1	0.6	0.7
70.	26	16.9	17.7
77.	2	1.3	1.4
84.	8	5.2	5.4
90.	5	3.2	3.4
112.	19	12.3	12.9
120.	1	0.6	0.7
140.	3	1.9	2.0
180.	1	0.6	0.7
190.	1	0.6	0.7
224.	7	4.5	4.8
270.	1	0.6	0.7
350.	2	1.3	1.4
365.	1	0.6	0.7
9999.	7	4.5	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

NOUT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
9.	2	1.3	1.3
10.	2	1.3	1.3
13.	1	0.6	0.7
15.	1	0.6	0.7
16.	2	1.3	1.3
20.	1	0.6	0.7
22.	2	1.3	1.3
23.	1	0.6	0.7
26.	4	2.6	2.7
27.	2	1.3	1.3
28.	2	1.3	1.3
29.	1	0.6	0.7
30.	21	13.6	14.0
31.	2	1.3	1.3
32.	2	1.3	1.3
33.	2	1.3	1.3
34.	2	1.3	1.3
36.	2	1.3	1.3
38.	3	1.9	2.0
39.	3	1.9	2.0
40.	4	2.6	2.7
42.	3	1.9	2.0
43.	2	1.3	1.3
45.	4	2.6	2.7

Table 9 (cont'd)

NOUT1 (cont'd)

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
46.	2	1.3	1.3
47.	1	0.6	0.7
48.	15	9.7	10.0
52.	1	0.6	0.7
54.	9	5.8	6.0
56.	3	1.9	2.0
58.	2	1.3	1.3
63.	1	0.6	0.7
66.	6	3.9	4.0
73.	4	2.6	2.7
74.	2	1.3	1.3
76.	6	3.9	4.0
81.	2	1.3	1.3
82.	1	0.6	0.7
88.	2	1.3	1.3
90.	8	5.2	5.3
104.	2	1.3	1.3
110.	6	3.9	4.0
114.	1	0.6	0.7
124.	1	0.6	0.7
129.	1	0.6	0.7
203.	2	1.3	1.3
223.	1	0.6	0.7
9999.	4	2.6	MISSING
TOTAL	154	100.0	

Table 9 (cont'd)

CRIOUT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	7	4.5	4.5
2.	33	21.4	21.4
8.	3	1.9	1.9
9.	1	0.6	0.6
10.	1	0.6	0.6
14.	5	3.2	3.2
15.	3	1.9	1.9
17.	2	1.3	1.3
18.	1	0.6	0.6
19.	4	2.6	2.6
20.	1	0.6	0.6
21.	18	11.7	11.7
22.	5	3.2	3.2
24.	13	8.4	8.4
26.	8	5.2	5.2
27.	6	3.9	3.9
28.	10	6.5	6.5
29.	4	2.6	2.6
30.	1	0.6	0.6
31.	5	3.2	3.2
34.	4	2.6	2.6
35.	3	1.9	1.9
42.	1	0.6	0.6
50.	1	0.6	0.6
51.	9	5.8	5.8
52.	1	0.6	0.6
54.	1	0.6	0.6
55.	3	1.9	1.9
TOTAL	154	100.0	100.0

Table 9 (cont'd)

MEATYP1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	16	10.4	10.5
2.	59	38.3	38.6
5.	78	50.6	51.0
9999.	1	0.6	MISSING
TOTAL	154	100.0	100.0

MSMET1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	31	20.1	21.2
2.	4	2.6	2.7
3.	24	15.6	16.4
4.	1	0.6	0.7
5.	50	32.5	34.2
6.	1	0.6	0.7
8.	35	22.7	24.0
9999.	8	5.2	MISSING
TOTAL	154	100.0	100.0

VALEST1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	55	35.7	98.2
2.	1	0.6	1.8
9999.	98	63.6	MISSING
TOTAL	154	100.0	100.0

Table X (cont'd)

TMMEA1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
2.	61	39.6	40.4
3.	80	51.9	53.0
4.	1	0.6	0.7
5.	9	5.8	6.0
9999.	3	1.9	MISSING
TOTAL	154	100.0	100.0

PREPOS1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	66	42.9	79.5
2.	16	10.4	19.3
3.	1	0.6	1.2
9999.	71	46.1	MISSING
TOTAL	154	100.0	100.0

REACT1

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	27	17.5	18.5
2.	60	39.0	41.1
3.	59	38.3	40.4
9999.	8	5.2	MISSING
TOTAL	154	100.0	100.0

Table 9 (cont'd)

COUNTRE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	43	27.9	27.9
2.	64	41.6	41.6
3.	31	20.1	20.1
4.	14	9.1	9.1
6.	2	1.3	1.3
TOTAL	154	100.0	100.0

Table 9 (cont'd)

CALC01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	97	63.0	63.0
2.	34	22.1	22.1
5.	1	0.6	0.6
6.	1	0.6	0.6
8.	5	3.2	3.2
9.	15	9.7	9.7
TOTAL	154	100.0	100.0

MEANS01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	84	54.5	56.0
4.	47	30.5	31.3
5.	19	12.3	12.7
9999.	4	2.6	MISSING
TOTAL	154	100.0	100.0

SIG01

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)
1.	11	7.1	7.7
2.	28	18.2	19.6
3.	34	22.1	23.8
4.	3	1.9	2.1
5.	67	43.5	46.9
9999.	11	7.1	MISSING
TOTAL	154	100.0	100.0

Table 10
Teacher Outcome Effect Sizes Across FORM

Form of Publication

(1) journal
(2) book
(3) MA thesis
(4) dissertation
(5) unpublished
(6) other

```
FOR ENTIRE POPULATION
SUM              130.550
MEAN               0.848
STD DEV            1.297
VARIANCE           1.682
N               (    154)

VARIABLE     FORM

CODE                  1.

SUM               74.640
MEAN               1.204
STD DEV            1.787
VARIANCE           3.192
N               (     62)

CODE                  3.

SUM                0.800
MEAN               0.800
STD DEV            0.0
VARIANCE           0.0
N               (      1)

CODE                  4.

SUM               49.830
MEAN               0.593
STD DEV            0.767
VARIANCE           0.589
N               (     84)

CODE                  5.

SUM                5.280
MEAN               0.754
STD DEV            0.238
VARIANCE           0.056
N               (      7)

  TOTAL CASES =       154
```

Table 11
Teacher Outcome Effect Sizes Across TYPE

Type of study

(1) correlational
(2) quasi-experimental
(3) experimental
(4) other

```
FOR ENTIRE POPULATION
SUM             126.650
MEAN              0.833
STD DEV           1.295
VARIANCE          1.677
N              (    152)

VARIABLE       TYPE

CODE                 2.

SUM              65.780
MEAN              0.953
STD DEV           1.666
VARIANCE          2.775
N              (     69)

CODE                 3.

SUM              40.090
MEAN              0.668
STD DEV           0.920
VARIANCE          0.847
N              (     60)

CODE                 4.

SUM              20.780
MEAN              0.903
STD DEV           0.731
VARIANCE          0.534
N              (     23)

   TOTAL CASES =       154
 MISSING CASES =         2 OR    1.3 PCT.
```

Table 12
Teacher Outcome Effect Sizes Across ASSIGN

Assignment of teachers to treatments

- (1) random
- (2) matched
- (3) self-selected
- (4) intact groups
- (5) representative sample
- (6) other

```
FOR ENTIRE POPULATION
SUM          124.090
MEAN           0.827
STD DEV        1.302
VARIANCE       1.695
N          (     150)

VARIABLE     ASSIGN

CODE              1.

SUM           40.870
MEAN           0.670
STD DEV        0.913
VARIANCE       0.833
N          (      61)

CODE              2.

SUM            2.200
MEAN           2.200
STD DEV        0.0
VARIANCE       0.0
N          (       1)

CODE              3.

SUM           22.560
MEAN           1.253
STD DEV        2.979
VARIANCE       8.875
N          (      18)

CODE              4.

SUM           49.490
MEAN           0.884
STD DEV        0.857
VARIANCE       0.735
N          (      56)

CODE              6.

SUM            8.970
MEAN           0.641
STD DEV        0.549
VARIANCE       0.301
N          (      14)

  TOTAL CASES =      154
MISSING CASES =        4 OR    2.6 PCT.
```

Table 13
Teacher Outcome Effect Sizes Across TUNIT

Teacher unit of analysis

(1) individual
(2) classroom
(3) school
(4) other

```
FOR ENTIRE POPULATION
SUM            127.950
MEAN             0.853
STD DEV          1.314
VARIANCE         1.726
N              (   150)

VARIABLE      TUNIT

CODE                1.

SUM            124.150
MEAN             0.856
STD DEV          1.328
VARIANCE         1.765
N              (   145)

CODE                2.

SUM              3.000
MEAN             0.750
STD DEV          0.996
VARIANCE         0.991
N              (     4)
```

Table 14
Teacher Outcome Effect Sizes Across VALID

Rates internal validity

(1) low
(2) medium
(3) high

```
FOR ENTIRE POPULATION
SUM          122.490
MEAN           0.828
STD DEV        1.311
VARIANCE       1.718
N          (     148)

VARIABLE    VALID

CODE              1.

SUM           26.570
MEAN           1.022
STD DEV        2.463
VARIANCE       6.066
N          (      26)

CODE              2.

SUM           40.460
MEAN           0.749
STD DEV        0.822
VARIANCE       0.676
N          (      54)

CODE              3.

SUM           55.460
MEAN           0.816
STD DEV        0.975
VARIANCE       0.951
N          (      68)

  TOTAL CASES =       154
MISSING CASES =         6 OR    3.9 PCT.
```

Table15
Teacher Outcome Effect Sizes Across RATE

Design Rating

(1) low
(2) medium
(3) high

```
FOR ENTIRE POPULATION
SUM             127.990
MEAN              0.842
STD DEV           1.304
VARIANCE          1.700
N              (    152)

VARIABLE     RATE

CODE                 1.

SUM              36.310
MEAN              0.865
STD DEV           2.046
VARIANCE          4.184
N              (     42)

CODE                 2.

SUM              25.670
MEAN              0.676
STD DEV           0.613
VARIANCE          0.375
N              (     38)

CODE                 3.

SUM              66.010
MEAN              0.917
STD DEV           0.992
VARIANCE          0.983
N              (     72)

  TOTAL CASES =        154
MISSING CASES =          2 OR   1.3 PCT.
```

Table 16
Teacher Outcome Effect Sizes Across TIME1

Time of treatment

(1) pre-service
(2) in-service
(3) other

```
FOR ENTIRE POPULATION
SUM           130.550
MEAN            0.848
STD DEV         1.297
VARIANCE        1.682
N          (      154)

VARIABLE   TIME1

CODE               1.

SUM            95.290
MEAN            0.781
STD DEV         0.895
VARIANCE        0.800
N          (      122)

CODE               2.

SUM            35.260
MEAN            1.102
STD DEV         2.257
VARIANCE        5.093
N          (       32)

  TOTAL CASES =       154
```

Table 17
Teacher Outcome Effect Sizes Across SITTRET1

Site of treatment

(1) field based, site of employment
(2) field based, not site of employment
(3) university based
(4) other

```
FOR ENTIRE POPULATION
SUM           108.630
MEAN            0.744
STD DEV         0.824
VARIANCE        0.679
N            (    146)

VARIABLE    SITTRET1

CODE               1.

SUM             3.710
MEAN            0.742
STD DEV         0.864
VARIANCE        0.746
N            (      5)

CODE               2.

SUM            15.440
MEAN            0.772
STD DEV         0.598
VARIANCE        0.357
N            (     20)

CODE               3.

SUM            86.010
MEAN            0.768
STD DEV         0.883
VARIANCE        0.779
N            (    112)

CODE               4.

SUM             3.470
MEAN            0.386
STD DEV         0.329
VARIANCE        0.108
N            (      9)

  TOTAL CASES =        154
MISSING CASES =          8 OR    5.2 PCT.
```

Table 18
Teacher Outcome Effect Sizes Across EXTTRET1

Extent of treatment

(1) multi-grade or level e.g. program
    or on-going institute
(2) one-grade or level e.g. course,
    workshop
(3) training technique
(4) other

```
FOR ENTIRE  POPULATION
SUM          130.550
MEAN           0.848
STD DEV        1.297
VARIANCE       1.682
N           (    154)

VARIABLE    EXTTRET1

CODE              1.

SUM            5.450
MEAN           0.454
STD DEV        0.456
VARIANCE       0.208
N           (     12)

CODE              2.

SUM           64.620
MEAN           0.923
STD DEV        1.633
VARIANCE       2.667
N           (     70)

CODE              3.

SUM           60.480
MEAN           0.840
STD DEV        0.984
VARIANCE       0.969
N           (     72)

  TOTAL CASES =       154
```

Table 19
Teacher Outcome Effect Sizes Across LEUTRET1

Treatment geared to grade level

```
(1) pre-school (5) high school
(2) elementary (6) general
    school     (7) other
(3) middle     (8) secondary
    school
(4) junior high
    school
```

```
                                     CODE                 5.
FOR ENTIRE POPULATION
SUM            130.400               SUM               1.500
MEAN             0.852               MEAN              0.500
STD DEV          1.300               STD DEV           0.460
VARIANCE         1.690               VARIANCE          0.211
N           (     153)               N           (        3)

                                     CODE                 6.
VARIABLE     LEUTRET1
                                     SUM              18.650
CODE                2.               MEAN              1.243
                                     STD DEV           0.969
SUM             93.960               VARIANCE          0.939
MEAN             0.764               N           (       15)
STD DEV          0.862
VARIANCE         0.743
N           (     123)

CODE                3.               CODE                 8.

SUM             -0.930               SUM               3.120
MEAN            -0.465               MEAN              0.390
STD DEV          0.304               STD DEV           0.325
VARIANCE         0.092               VARIANCE          0.106
N           (       2)               N           (        8)

CODE                4.                 TOTAL CASES =          154
                                     MISSING CASES =            1
SUM             14.100
MEAN             7.050
STD DEV          8.132
VARIANCE        66.125
N           (       2)
```

Table 20
Teacher Outcome Effect Sizes Across CRIOUT1

Knowledge and intellectual processes

(1) science content
(2) science processes
(3) knowledge of teaching strategies & classification and techniques
(4) learning theory
(5) learning styles
(6) learning skills
(7) lab skills
(8) methods of science and the scientific enterprise
(9) critical thinking
(10) creativity
(11) decision making
(12) logical thinking
(13) spatial reasoning
(14) problem solving
(15) behavior objectives
(17) planning (organizational skill)

Teacher classroom behaviors

(18) verbal behavior, general
(19) inquiry strategy
(20) concrete manipulative strategy
(21) indirect verbal behavior
(22) interpersonal behaviors (response behavior, accepting verbal interaction, rapport) relationships
(23) wait-time
(24) questioning-level
(25) classroom management
(26) discovery strategy (student centered, Open)

Affective

(27) attitude (general)
(28) attitude toward science
(29) attitude toward science teaching
(30) attitude toward treatment
(31) dogmatism (toward open)
(32) self-concept
(33) values

Table 20 (cont'd)

(34) philosophy of teaching (perceived role expectation toward student centered)
(54) attitude toward treatment emphasis.

Curriculum related

(35) characteristics
(36) implementation

(37)
(38) ESS
(40) Scis
(41) SAPA
(42)

Misc. added during coding

(50) group process skills
(51) questions-process directed
(52) reactions to classroom situations
(53) leadership or change-agent strategies

CODE	MEAN	STD DEV	N
1.	0.5171	0.7900	(7)
2.	1.0770	1.0348	(33)
8.	0.1433	0.7427	(3)
9.	0.0900	0.0	(1)
10.	0.1900	0.0	(1)
14.	0.0380	0.2269	(5)
15.	0.7500	0.1375	(3)
17.	0.8950	0.1202	(2)
18.	0.1500	0.0	(1)
19.	0.8875	0.4720	(4)
20.	1.2600	0.0	(1)
21.	0.7206	0.8209	(18)
22.	0.5400	0.2597	(5)
24.	0.7200	1.1798	(13)
→ 26.	2.2150	4.3046	(8)
27.	0.7850	0.5593	(6)
28.	0.3890	0.2935	(10)
29.	0.0850	0.2062	(4)
30.	0.4600	0.0	(1)
31.	0.3420	0.3375	(5)
34.	0.7175	0.6541	(4)
35.	1.7600	1.8824	(3)
42.	1.6200	0.0	(1)
50.	0.2600	0.0	(1)
51.	1.4456	0.5957	(9)
52.	0.8400	0.0	(1)
54.	0.6000	0.0	(1)
55.	1.0500	1.9151	(3)

[illegible] – Group [illegible]

Table 21
Teacher Outcome Effect Sizes Across MEATYP1

Measurement type

(1) published-national standardized
(2) ad-hoc, for that study
(3) departmental or local standard
(4) classroom based teacher developed
(5) other

```
FOR ENTIRE POPULATION
SUM           130.330
MEAN            0.852
STD DEV         1.300
VARIANCE        1.690
N          (     153)

VARIABLE    MEATYP1

CODE               1.

SUM             5.580
MEAN            0.349
STD DEV         0.584
VARIANCE        0.341
N          (      16)

CODE               2.

SUM            65.980
MEAN            1.118
STD DEV         0.945
VARIANCE        0.892
N          (      59)

CODE               5.

SUM            58.770
MEAN            0.753
STD DEV         1.575
VARIANCE        2.482
N          (      78)

  TOTAL CASES =       154
MISSING CASES =         1 OR    0.6 PCT.
```

Table 22
Teacher Outcome Effect Sizes Across MSMET1

Measurement method

(1) multiple-choice
(2) semantic differential
(3) Likert
(4) questionnaire
(5) observation
(6) interview
(7) Q-sort
(8) other

```
FOR ENTIRE POPULATION                          CODE                  4.
SUM            124.300
MEAN             0.851                         SUM               0.020
STD DEV          1.319                         MEAN              0.020
VARIANCE         1.739                         STD DEV           0.0
N              (   146)                        VARIANCE          0.0
                                               N              (     1)

VARIABLE       MSMET1                          CODE                  5.

CODE                1.                         SUM              53.820
                                               MEAN              1.076
SUM             14.990                         STD DEV           1.927
MEAN             0.484                         VARIANCE          3.715
STD DEV          0.610                         N              (    50)
VARIANCE         0.373
N              (    31)
                                               CODE                  6.
CODE                2.
                                               SUM               0.180
SUM              3.310                         MEAN              0.180
MEAN             0.827                         STD DEV           0.0
STD DEV          0.701                         VARIANCE          0.0
VARIANCE         0.492                         N              (     1)
N              (     4)
                                               CODE                  8.
CODE                3.
                                               SUM              40.020
SUM             11.960                         MEAN              1.143
MEAN             0.498                         STD DEV           1.072
STD DEV          0.443                         VARIANCE          1.149
VARIANCE         0.196                         N              (    35)
N              (    24)
                                                  TOTAL CASES =         154
                                               MISSING CASES =           8
```

Table 23
Teacher Outcome Effect Sizes Across TMMEA1

Time of measurement

(1) before treatment
(2) after treatment
(3) pre-post
(4) delayed
(5) other

```
FOR ENTIRE POPULATION
SUM               128.560
MEAN                0.851
STD DEV             1.309
VARIANCE            1.713
N                (    151)

VARIABLE     TMMEA1

CODE                   2.

SUM                49.820
MEAN                0.817
STD DEV             1.730
VARIANCE            2.994
N                (     61)

CODE                   3.

SUM                72.060
MEAN                0.901
STD DEV             0.964
VARIANCE            0.929
N                (     80)

CODE                   4.

SUM                 0.020
MEAN                0.020
STD DEV             0.0
VARIANCE            0.0
N                (      1)

CODE                   5.

SUM                 6.660
MEAN                0.740
STD DEV             0.593
VARIANCE            0.351
N                (      9)

   TOTAL CASES =       154
 MISSING CASES =         3 OR    1.9 PCT.
```

Table 24
Teacher Outcome Effect Sizes Across CALC01

Calculation of effect size

(1) directly from reported data or raw data (means & variations)
(2) reported with direct estimates (ANOVA, t, F)
(3) directly from frequencies reported on ordinal scale (probit, X^2)
(4) Backwars from variance of means with randomly assigned groups
(5) nonparametrics (other than #3)
(6) guessed from independent sources (test manuals, other students using the same test, conventional wisdom)
(7) estimated from variance of gain scores (correlation estimating)
(8) probability levels
(9) pre-test data used as a control group

```
FOR ENTIRE POPULATION
SUM              130.550
MEAN               0.848
STD DEV            1.297
VARIANCE           1.682
N               (    154)

VARIABLE      CALC01

CODE                  0.

SUM                0.640
MEAN               0.640
STD DEV            0.0
VARIANCE           0.0
N               (      1)

CODE                  1.

SUM               82.260
MEAN               0.848
STD DEV            1.516
VARIANCE           2.300
N               (     97)

CODE                  2.

SUM               28.470
MEAN               0.837
STD DEV            0.874
VARIANCE           0.765
N               (     34)

CODE                  5.

SUM                0.980
MEAN               0.980
STD DEV            0.0
VARIANCE           0.0
N               (      1)

CODE                  6.

SUM               -0.600
MEAN              -0.600
STD DEV            0.0
VARIANCE           0.0
N               (      1)

CODE                  8.

SUM                3.540
MEAN               0.708
STD DEV            0.147
VARIANCE           0.022
N               (      5)

CODE                  9.

SUM               15.260
MEAN               1.017
STD DEV            0.782
VARIANCE           0.611
N               (     15)

    TOTAL CASES =      154
```

Table 25
Analysis of Variance
Teacher Outcome Effect Sizes Across CALC01

```
SOURCE             SUM OF SQUARES   D.F..  MEAN SQUARE      F       SIG.

BETWEEN GROUPS              2.689      6         0.448   0.259   0.9550

   LINEARITY                0.072      1         0.072   0.042   0.8387
   DEV. FROM L              2.617      5         0.523   0.302   0.9109

                  R   = 0.0167   R SQUARED   = 0.0003

WITHIN GROUPS             254.645    147         1.732

                  ETA = 0.1022   ETA SQUARED = 0.0105
```

Table 26
Teacher Outcome Effect Sizes Across MEANS01

Source of means

(1) unadjusted post-test
(2) covariance
(3) residual gains
(4) pre-post differences
(5) other

```
FOR ENTIRE POPULATION
SUM             127.950
MEAN              0.853
STD DEV           1.314
VARIANCE          1.726
N               (   150)

VARIABLE     MEANS01

CODE                 1.

SUM              64.430
MEAN              0.767
STD DEV           1.517
VARIANCE          2.302
N               (    84)

CODE                 4.

SUM              46.780
MEAN              0.995
STD DEV           1.086
VARIANCE          1.185
N               (    47)

CODE                 5.

SUM              16.740
MEAN              0.881
STD DEV           0.746
VARIANCE          0.556
N               (    19)

  TOTAL CASES =        154
MISSING CASES =          4 OR    2.6 PCT.
```

Table 27
Teacher Outcome Effect Sizes Across SIG01

Significance

(1) p ≤ .005
(2) p ≤ .01
(3) p ≤ .05
(4) p ≤ .10
(5) p > .10

```
FOR ENTIRE POPULATION
SUM               122.210
MEAN                0.855
STD DEV             1.326
VARIANCE            1.759
N                (    143)

VARIABLE      SIG01

CODE                   1.

SUM                16.820
MEAN                1.529
STD DEV             0.838
VARIANCE            0.703
N                (     11)

CODE                   2.

SUM                45.950
MEAN                1.641
STD DEV             2.319
VARIANCE            5.379
N                (     28)

CODE                   3.

SUM                39.100
MEAN                1.150
STD DEV             1.035
VARIANCE            1.071
N                (     34)

CODE                   4.

SUM                 2.160
MEAN                0.720
STD DEV             0.192
VARIANCE            0.037
N                (      3)

CODE                   5.

SUM                18.160
MEAN                0.271
STD DEV             0.460
VARIANCE            0.212
N                (     67)


   TOTAL CASES =        154
 MISSING CASES =         11 OR    7.1 PCT.
```

Table 28
Teacher Outcome Effect Sizes Across COUNTRE

The number of variables (TRTY101-TRTY110) used to describe each treatment.

```
FOR ENTIRE POPULATION
SUM             130.550
MEAN              0.848
STD DEV           1.297
VARIANCE          1.682
N             (    154)

VARIABLE    COUNTRE

CODE                 1.

SUM              41.100
MEAN              0.956
STD DEV           1.932
VARIANCE          3.733
N             (     43)

CODE                 2.

SUM              41.370
MEAN              0.646
STD DEV           0.893
VARIANCE          0.798
N             (     64)

CODE                 3.

SUM              22.740
MEAN              0.734
STD DEV           0.620
VARIANCE          0.385
N             (     31)

CODE                 4.

SUM              17.440
MEAN              1.246
STD DEV           1.028
VARIANCE          1.058
N             (     14)

CODE                 6.

SUM               7.900
MEAN              3.950
STD DEV           0.071
VARIANCE          0.005
N             (      2)
```

Table 28
Teacher Outcome Effect Sizes Across TRTY101-110

Treatment type: (Use 1-10 variables as appropriate)

Organization

(1) competency based program
(2) field based program
(3) ongoing institute
(4) summer institute
(5) workshop
(6) methods course
(7) science course
(8) science course designed for teachers
(9) minicourse
(10) units of study
(11)

Instructional Exposure, strategy

(12) general
(13) traditiional
(14) inquiry
(15) discovery
(16)

Instructional Exposure, mode

(17) verbal
(18) mixed
(19) concrete
(20)

CODE	MEAN	STD DEV	N
2.	0.3512	0.4043	8)
3.	0.6350	0.9405	2)
4.	0.1433	0.0924	3)
5.	1.4388	3.0156	17)
6.	0.7882	0.9416	22)
7.	1.2800	0.4808	2)
8.	0.9711	0.6953	9)
10.	1.3759	1.2937	22)
12.	0.7926	1.2133	35)
13.	0.3000	0.3158	5)
14.	0.6311	0.6320	9)
15.	0.3986	0.2948	7)
19.	0.7530	0.7548	20)
17.	-0.0250	0.1768	2)
18.	0.4450	0.8577	12)
25.	0.0350	0.4629	8)

workshop — [illegible] → 5.
[illegible] — [illegible] — see page
22 of TRST progr
for N = 16

Table 28 (cont'd)

Instructional exposure, interaction

(21) direct
(22) mixed
(23) indirect
(24)

Instructional exposure, source of structure

(25) student self-directed
(26) student interacting with materials and/or teacher
(27) teacher
(28) criterion referenced

Instructional exposure, focus of control

(29) student self-directed
(30) student and teacher working together
(31) teacher directed
(32) mix, part student, part teacher

Technique

(33) I A feedback
(34) instructional strategy feedback
(35) wait-time analysis
(36) questioning analysis
(37) micro-teaching peers
(38) micro-teaching students
(39) modeling strategy
(40) behavior coding training (eg IA) or strategy analysis
(56) interview training
(57) question construction
(58) persuasive communication

Technology

(41) audio technology
(42) video technology
(43) computer technology
(44) programmed material (a-t)
(45) print material

CODE	MEAN	STD DEV	N
28.	0.6850	0.0212	2)
26.	0.7037	1.0137	8)
29.	0.8170	0.8841	44)
31.	1.4400	0.0	1)
35.	3.9500	0.0707	2)
34.	0.6730	0.9123	10)
37.	0.7175	0.3466	4)
39.	1.5643	1.1930	14)
40.	1.3700	0.8653	8)
33.	1.3300	0.0	1)
36.	1.3800	1.6545	8)
38.	0.8100	0.5151	6)
57.	1.2267	0.9632	6)
58.	1.2500	1.0207	4)
41.	1.0375	0.2546	4)
42.	1.8167	1.4404	9)
44.	0.9859	0.7646	17)
45.	1.4000	0.0	1)

Table 29
Pearson Correlation Coefficients
Effect Size (EFSIZE01) with Selected Independent Variables
(Coefficient/ (cases) /Significance)

FORM	-0.2210 (154) P=0.006	VALID	-0.0408 (148) P=0.623	NTREAT1	-0.1031 (154) P=0.203
TYPE	-0.0475 (152) P=0.562	RATE	0.0266 (152) P=0.745	SPONS1	0.1170 (19) P=0.633
OUTON	-0.0955 (154) P=0.239	DATPRE	0.0240 (149) P=0.771	TIME1	0.1007 (154) P=0.214
ASSIGN	0.0402 (150) P=0.625	CHAR	0.0908 (153) P=0.264	SITTRET1	-0.0560 (146) P=0.502
ASINUM	-0.0190 (153) P=0.815	SAMP	-0.1612 (153) P=0.047	EXTTRET1	0.0334 (154) P=0.681
ANAL	-0.0179 (154) P=0.825	FEMALE	-0.0847 (36) P=0.623	LEUTRET1	0.0586 (153) P=0.472
PER	-0.0930 (150) P=0.258	EDUBACK	0.0879 (141) P=0.300	DUR1	-0.0676 (147) P=0.416
TUNIT	-0.0073 (150) P=0.930	MAJOR	-0.0803 (34) P=0.652	CONTACT1	0.0521 (142) P=0.538
TCOR	0.0606 (142) P=0.474	MINOR	99.0000 (5) P=*****	FID1	-0.0190 (153) P=0.816
STUASSIG	-0.1487 (34) P=0.401	LEVEL	0.0374 (56) P=0.784	CONTYPE1	99.0000 (150) P=*****
ASINUMS	-0.2599 (21) P=0.255	DEGREE	0.0190 (125) P=0.833	NOUT1	-0.1428 (150) P=0.081
ANAGSTU	-0.2799 (27) P=0.157	EXPT	-0.0146 (136) P=0.866	CRIOUT1	0.0482 (154) P=0.553
SUNIT	0.1216 (33) P=0.500	EXPTCHS	-0.0564 (117) P=0.546	MEATYP1	-0.0463 (153) P=0.570
SCOR	-0.1253 (37) P=0.460	STUSAMP	-0.0735 (30) P=0.699	INTENT1	-0.0616 (154) P=0.448

Table 29 (cont'd)

MSMET1	0.1964	(140)	P=0.018	IORELI1	0.2320	(41)	P=0.144
REL1	0.1498	(77)	P=0.193	FORREL1	0.1846	(40)	P=0.254
RELM1	-0.0882	(50)	P=0.543	FORIOR1	0.1369	(33)	P=0.447
VALEST1	-0.0872	(56)	P=0.523	CALCO1	0.0167	(154)	P=0.837
TMMEA1	-0.0048	(151)	P=0.953	INSTO1	-0.0122	(153)	P=0.881
PREPOS1	-0.1448	(83)	P=0.192	MEANSO1	0.0681	(150)	P=0.408
REACT1	0.0492	(146)	P=0.555	SIGO1	-0.4288	(143)	P=0.000
CEIL1	0.0728	(79)	P=0.524	COUNTRE	0.1376	(154)	P=0.089

Table 30

Stepwise Regression Analysis for the Prediction of Teacher Outcome Effect Size, First Variable to Enter

```
VARIABLE(S) ENTERED ON STEP NUMBER  1..     SIG01

MULTIPLE R            0.42881
R SQUARE              0.18388
ADJUSTED R SQUARE     0.17724
STANDARD ERROR        1.17636



ANALYSIS OF VARIANCE    DF        SUM OF SQUARES  MEAN SQUARE    F
REGRESSION               1.            38.34949     38.34949  27.71289
RESIDUAL               123.           170.20915      1.38381



--------------- VARIABLES IN THE EQUATION ---------------

VARIABLE          B            BETA      STD ERROR B       F

SIG01      -0.3891005      -0.42881        0.07391      27.713
(CONSTANT)  2.251754
```

Table 31
Stepwise Regression Analysis for the Prediction of
Teacher Outcome Effect Size, Second Variable to Enter

```
          VARIABLE(S) ENTERED ON STEP NUMBER  2..      NOUT1

          MULTIPLE R           0.45149
          R SQUARE             0.20384
          ADJUSTED R SQUARE    0.19079
          STANDARD ERROR       1.16663



ANALYSIS OF VARIANCE      DF        SUM OF SQUARES  MEAN SQUARE    F
REGRESSION                 2.            42.51361     21.25680  15.61823
RESIDUAL                 122.           166.04504      1.36102



 ---------------- VARIABLES IN THE EQUATION -----------------
 VARIABLE            B              BETA       STD ERROR B        F

 SIG01       -0.3886393         -0.42830        0.07330        28.110
 NOUT1       -0.5321100D-02     -0.14130        0.00304         3.060
 (CONSTANT)   2.541580
```

Table 232
Stepwise Regression Analysis for the Prediction of
Teacher Outcome Effect Size, Third Variable to Enter

```
VARIABLE(S) ENTERED ON STEP NUMBER  3..    CALC01

MULTIPLE R              0.47452
R SQUARE                0.22516
ADJUSTED R SQUARE       0.20595
STANDARD ERROR          1.15565



ANALYSIS OF VARIANCE       DF        SUM OF SQUARES    MEAN SQUARE      F
REGRESSION                  3.            46.96000        15.65333  11.72073
RESIDUAL                  121.           161.59864         1.33553



---------------- VARIABLES IN THE EQUATION ----------------

VARIABLE            B              BETA        STD ERROR B         F

SIG01      -0.4320366          -0.47613        0.07641        31.971
NOUT1      -0.6220766D-02      -0.16519        0.00305         4.150
CALC01     -0.7777221D-01      -0.15552        0.04262         3.329
(CONSTANT)  2.924718
```

Table 33
Stepwise Regression Analysis for the Prediction of Teacher Outcome Effect Size, Fourth Variable to Enter

```
VARIABLE(S) ENTERED ON STEP NUMBER  4..     VALID

MULTIPLE R              0.49754
R SQUARE                0.24755
ADJUSTED R SQUARE       0.22247
STANDARD ERROR          1.14357


ANALYSIS OF VARIANCE        DF        SUM OF SQUARES  MEAN SQUARE     F
REGRESSION                   4.             51.62807     12.90702  9.86960
RESIDUAL                   120.            156.93058      1.30775


------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE               B              BETA      STD ERROR B         F

SIG01       -0.4552562           -0.50172          0.07660      35.321
NOUT1       -0.7693018D-02       -0.20429          0.00312       6.078
CALC01      -0.9589804D-01       -0.19176          0.04326       4.915
VALID       -0.2737394           -0.15772          0.14489       3.570
(CONSTANT)   3.755628
```

Table 34
Stepwise Regression Analysis for the Prediction of
Teacher Outcome Effect Size, Fifth Variable to Enter

```
          VARIABLE(S) ENTERED ON STEP NUMBER  5..     COUNTRE

             MULTIPLE R            0.51206
             R SQUARE              0.26221
             ADJUSTED R SQUARE     0.23121
             STANDARD ERROR        1.13712




ANALYSIS OF VARIANCE      DF        SUM OF SQUARES  MEAN SQUARE    F
REGRESSION                 5.            54.68580    10.93716   8.45843
RESIDUAL                 119.           153.87285     1.29305




----------------- VARIABLES IN THE EQUATION ------------------
VARIABLE              B             BETA      STD ERROR B       F

SIG01      -0.4414027          -0.48645        0.07670       33.118
NOUT1      -0.85628390D-02     -0.22739        0.00315        7.371
CALC01     -0.1051110          -0.21019        0.04343        5.859
VALID      -0.3086581          -0.17796        0.14587        4.483
COUNTRE     0.1611365           0.12637        0.10479        2.365
(CONSTANT)  3.507104
```

Table 35
Stepwise Regression Analysis for the Prediction of
Teacher Outcome Effect Size, Sixth Variable to Enter

```
VARIABLE(S) ENTERED ON STEP NUMBER  6..      EXPT

MULTIPLE R               0.52201
R SQUARE                 0.27249
ADJUSTED R SQUARE        0.23550
STANDARD ERROR           1.13394



ANALYSIS OF VARIANCE        DF        SUM OF SQUARES   MEAN SQUARE     F
REGRESSION                   6.            56.83082       9.47180   7.36630
RESIDUAL                   118.           151.72783       1.28583



--------------- VARIABLES IN THE EQUATION ------------------

VARIABLE              B              BETA      STD ERROR B        F

SIG01        -0.4431158         -0.48834        0.07650       33.553
NOUT1        -0.9822922D-02     -0.26085        0.00329        8.898
CALC01       -0.1033923         -0.20675        0.04333        5.695
VALID        -0.4045680         -0.23310        0.16325        6.142
COUNTRE       0.1674532          0.13132        0.10461        2.563
EXPT         -0.4519776D-01     -0.11696        0.03499        1.668
(CONSTANT)    3.839191
```

Table 36
Stepwise Regression Analysis for the Prediction of
Teacher Outcome Effect Size, Seventh Variable to Enter

```
VARIABLE(S) ENTERED ON STEP NUMBER  7..    TIME1

MULTIPLE R              0.53173
R SQUARE                0.28273
ADJUSTED R SQUARE       0.23982
STANDARD ERROR          1.13074



ANALYSIS OF VARIANCE       DF       SUM OF SQUARES   MEAN SQUARE    F
REGRESSION                  7.         58.96634        8.42376    6.58844
RESIDUAL                  117.        149.59231        1.27857



---------------- VARIABLES IN THE EQUATION ------------------
VARIABLE          B               BETA       STD ERROR B        F

SIG01       -0.4373497         -0.48198       0.07641        32.759
NOUT1       -0.9276463D-02     -0.24634       0.00331         7.850
CALC01      -0.1054320         -0.21083       0.04323         5.948
VALID       -0.3793667         -0.21858       0.16395         5.354
COUNTRE      0.1850582          0.14513       0.10520         3.095
EXPT        -0.7009098D-01     -0.18138       0.03986         3.092
TIME1        0.4068120          0.12768       0.31478         1.670
(CONSTANT)   3.236997
```

Table 37
Stepwise Regression Analysis for the
Predicion of Teacher Outcome Effect Size, Summary Table

SUMMARY TABLE

VARIABLE	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R
SIG01	0.42881	0.18388	0.18388	-0.42881
NOUT1	0.45149	0.20384	0.01997	-0.14284
CALC01	0.47452	0.22516	0.02132	0.01673
VALID	0.49754	0.24755	0.02238	-0.04078
COUNTRE	0.51206	0.26221	0.01466	0.13763
EXPT	0.52201	0.27249	0.01028	-0.01460
TIME1	0.53173	0.28273	0.01024	0.10069
MEANS01	0.53781	0.28924	0.00651	0.06811
DUR1	0.54763	0.29990	0.01065	-0.06764
LEUTRET1	0.55748	0.31078	0.01089	0.05855
FORM	0.56538	0.31966	0.00887	-0.22098
TUNIT	0.57060	0.32559	0.00593	-0.00726
MSMET1	0.57647	0.33232	0.00673	0.19640
EXTTRET1	0.58145	0.33808	0.00576	0.03336
REACT1	0.58427	0.34137	0.00329	0.04921
EDUBACK	0.58706	0.34464	0.00326	0.08787
TYPE	0.58958	0.34761	0.00297	-0.06724
ASSIGN	0.59086	0.34912	0.00151	0.04022
RATE	0.59149	0.34986	0.00074	0.02665
TMMEA1	0.59182	0.35025	0.00040	-0.00485
SITTRET1	0.59193	0.35038	0.00013	-0.05598
MEATYP1	0.59201	0.35048	0.00010	-0.04627
(CONSTANT)				

Table 38
Inquiry Outcome Effect Sizes Across FORM

Form of Publication

(1) journal (4) dissertation
(2) book (5) unpublished
(3) MA thesis (6) other

```
FOR ENTIRE POPULATION
SUM             94.850
MEAN             1.054
STD DEV          1.547
VARIANCE         2.393
N            (      90)

VARIABLE     FORM

CODE                1.

SUM             56.340
MEAN             1.610
STD DEV          2.179
VARIANCE         4.747
N            (      35)

CODE                3.

SUM              0.800
MEAN             0.800
STD DEV          0.0
VARIANCE         0.0
N            (       1)

CODE                4.

SUM             33.690
MEAN             0.702
STD DEV          0.848
VARIANCE         0.720
N            (      48)

CODE                5.

SUM              4.020
MEAN             0.670
STD DEV          0.090
VARIANCE         0.008
N            (       6)

  TOTAL CASES =        90
```

Table 39
Inquiry Outcome Effect Sizes Across TYPE

Type of study

(1) correlational
(2) quasi-experimental
(3) experimental
(4) other

```
FOR ENTIRE POPULATION
SUM              90.950
MEAN              1.034
STD DEV           1.552
VARIANCE          2.410
N               (    88)

VARIABLE    TYPE

CODE                 2.

SUM              49.980
MEAN              1.351
STD DEV           2.153
VARIANCE          4.633
N               (    37)

CODE                 3.

SUM              30.180
MEAN              0.794
STD DEV           0.944
VARIANCE          0.892
N               (    38)

CODE                 4.

SUM              10.790
MEAN              0.830
STD DEV           0.533
VARIANCE          0.26[illegible]
N               (    [illegible])

  TOTAL CASES =          90
MISSING CASES =           2 OR   2.2 PCT.
```

Table 40
Inquiry Outcome Effect Sizes Across ASSIGN

Assignment of teachers to treatments

- (1) random
- (2) matched
- (3) self-selected
- (4) intact groups
- (5) representative sample
- (6) other

```
FOR ENTIRE  POPULATION
SUM           90.950
MEAN           1.034
STD DEV        1.552
VARIANCE       2.410
N           (    88)

VARIABLE    ASSIGN

CODE              1.

SUM           30.960
MEAN           0.794
STD DEV        0.932
VARIANCE       0.868
N           (    39)

CODE              2.

SUM            2.200
MEAN           2.200
STD DEV        0.0
VARIANCE       0.0
N           (     1)

CODE              3.

SUM           15.390
MEAN           3.078
STD DEV        5.445
VARIANCE      29.646
N           (     5)

CODE              4.

SUM           35.700
MEAN           1.050
STD DEV        0.955
VARIANCE       0.911
N           (    34)

CODE              6.

SUM            6.700
MEAN           0.744
STD DEV        0.583
VARIANCE       0.340
N           (     9)
```

Table 41
Inquiry Outcome Effect Sizes Across TUNIT

Teacher unit of analysis

(1) individual
(2) classroom
(3) school
(4) other

```
FOR ENTIRE POPULATION
SUM               92.250
MEAN               1.073
STD DEV            1.580
VARIANCE           2.497
N              (      86)

VARIABLE      TUNIT

CODE                  1.

SUM               88.390
MEAN               1.079
STD DEV            1.610
VARIANCE           2.594
N              (      82)

CODE                  2.

SUM                3.060
MEAN               1.020
STD DEV            1.024
VARIANCE           1.049
N              (       3)
```

Table 42
Inquiry Outcome Effect Sizes Across VALID

Rates internal validity

(1) low
(2) medium
(3) high

```
FOR ENTIRE POPULATION
SUM             89.350
MEAN             1.039
STD DEV          1.570
VARIANCE         2.465
N           (      86)

VARIABLE      VALID

CODE                1.

SUM             22.710
MEAN             1.514
STD DEV          3.183
VARIANCE        10.129
N           (      15)

CODE                2.

SUM             27.370
MEAN             0.944
STD DEV          0.974
VARIANCE         0.949
N           (      29)

CODE                3.

SUM             39.270
MEAN             0.935
STD DEV          0.951
VARIANCE         0.904
N           (      42)

  TOTAL CASES =         90
MISSING CASES =          4 OR    4.4 PCT.
```

Table 43
Inquiry Outcome Effect Sizes Across RATE

Design Rating

(1) low
(2) medium
(3) high

```
FOR ENTIRE POPULATION
SUM                  94.850
MEAN                  1.054
STD DEV               1.547
VARIANCE              2.393
N               (       90)

VARIABLE        RATE

CODE                     1.

SUM                  25.530
MEAN                  1.021
STD DEV               2.569
VARIANCE              6.599
N               (       25)

CODE                     2.

SUM                  19.310
MEAN                  0.772
STD DEV               0.609
VARIANCE              0.371
N               (       25)

CODE                     3.

SUM                  50.010
MEAN                  1.250
STD DEV               1.039
VARIANCE              1.081
N               (       40)

  TOTAL CASES =          90
```

Table 44
Inquiry Outcome Effect Sizes Across TIME1

Time of treatment

(1) pre-service
(2) in-service
(3) other

```
FOR ENTIRE  POPULATION
SUM               94.850
MEAN               1.054
STD DEV            1.547
VARIANCE           2.393
N              (     90)

VARIABLE     TIME1

CODE                  1.

SUM               69.940
MEAN               0.945
STD DEV            0.962
VARIANCE           0.925
N              (     74)

CODE                  2.

SUM               24.910
MEAN               1.557
STD DEV            3.061
VARIANCE           9.370
N              (     16)

   TOTAL CASES =          90
```

Table 45
Inquiry Outcome Effect Sizes Across SITTRET1

Site of treatment

(1) field based, site of
    employment
(2) field based, not site of
    employment
(3) university based
(4) other

```
FOR ENTIRE POPULATION
SUM               76.790
MEAN               0.883
STD DEV            0.839
VARIANCE           0.704
N               (    87)

VARIABLE      SITTRET1

CODE                  1.

SUM                3.710
MEAN               0.742
STD DEV            0.864
VARIANCE           0.746
N               (     5)

CODE                  2.

SUM               14.740
MEAN               1.053
STD DEV            0.439
VARIANCE           0.192
N               (    14)

CODE                  3.

SUM               57.060
MEAN               0.878
STD DEV            0.917
VARIANCE           0.841
N               (    65)

CODE                  4.

SUM                1.280
MEAN               0.427
STD DEV            0.216
VARIANCE           0.047
N               (     3)

  TOTAL CASES =          90
MISSING CASES =           3 OR    3.3 PCT.
```

Table 46
Inquiry Outcome Effect Sizes Across EXTTRET1

Extent of treatment

(1) multi-grade or level e.g. program
or on-going institute
(2) one-grade or level e.g. course,
workshop
(3) training technique
(4) other

```
FOR ENTIRE POPULATION
SUM             94.850
MEAN             1.054
STD DEV          1.547
VARIANCE         2.393
N              (    90)

VARIABLE      EXTTRET1

CODE                1.

SUM              4.340
MEAN             0.620
STD DEV          0.496
VARIANCE         0.246
N              (     7)

CODE                2.

SUM             41.440
MEAN             1.219
STD DEV          2.218
VARIANCE         4.918
N              (    34)

CODE                3.

SUM             49.070
MEAN             1.001
STD DEV          0.988
VARIANCE         0.975
N              (    49)

   TOTAL CASES =        90
```

Table 47
Inquiry Outcome Effect Sizes Across LEUTRET1

Treatment geared to grade level

(1) pre-school
(2) elementary school
(3) middle school
(4) junior high school
(5) high school
(6) general
(7) other
(8) secondary

```
FOR ENTIRE  POPULATION          CODE                5.
SUM             94.850
MEAN             1.054          SUM              1.500
STD DEV          1.547          MEAN             0.500
VARIANCE         2.393          STD DEV          0.460
N              (   90)          VARIANCE         0.211
                                N              (    3)

VARIABLE    LEUTRET1            CODE                6.

CODE                2.          SUM             13.540
                                MEAN             1.231
SUM             63.390          STD DEV          0.767
MEAN             0.932          VARIANCE         0.588
STD DEV          0.963          N              (   11)
VARIANCE         0.928
N              (   68)

CODE                3.          CODE                8.

SUM             -0.680          SUM              3.000
MEAN            -0.680          MEAN             0.600
STD DEV          0.0            STD DEV          0.185
VARIANCE         0.0            VARIANCE         0.034
N              (    1)          N              (    5)

CODE                4.            TOTAL CASES =        90

SUM             14.100
MEAN             7.050
STD DEV          8.132
VARIANCE        66.125
N              (    2)
```

Table 48
Inquiry Outcome Effect Sizes Across CRIOUT1

Knowledge and intellectual processes

(1) science content
(2) science processes
(3) knowledge of teaching strategies & classification and techniques
(4) learning theory
(5) learning styles
(6) learning skills
(7) lab skills
(8) methods of science and the scientific enterprise
(9) critical thinking
(10) creativity

(11) decision making
(12) logical thinking
(13) spatial reasoning
(14) problem solving
(15) behavior objectives
(17) planning (organizational skill)

Teacher classroom behaviors

(18) verbal behavior, general
(19) inquiry strategy
(20) concrete manipulative strategy
(21) indirect verbal behavior
(22) interpersonal behaviors (response behavior, accepting verbal interaction, rapport) relationships
(23) wait-time
(24) questioning-level
(25) classroom management
(26) discovery strategy (student centered, Open)

Affective

(27) attitude (general)
(28) attitude toward science
(29) attitude toward science teaching
(30) attitude toward treatment
(31) dogmatism (toward open)
(32) self-concept
(33) values

Table 48 (cont'd)

(34) philosophy of teaching (perceived role expectation toward student centered)
(54) attitude toward treatment emphasis.

Curriculum related

(35) characteristics
(36) implementation

(37)
(38) ESS
(40) Scis
(41) SAPA
(42)

Misc. added during coding

(50) group process skills
(51) questions-process directed.
(52) reactions to classroom situations
(53) leadership or change-agent strategies

```
    CODE          MEAN          STD DEV               N

     2.          1.0770          1.0348    (         53)
    19.          0.8875          0.4720    (          4)
    21.          0.7206          0.8209    (         16)
    22.          0.5400          0.2597    (          5)
    24.          0.7200          1.1798    (         13)
    26.          2.2150          4.3046    (          8)
    51.          1.4456          0.5957    (          9)
```

Table 49
Inquiry Outcome Effect Sizes Across MEATYP1

Measurement type
- (1) published-national standardized
- (2) ad-hoc, for that study
- (3) departmental or local standard
- (4) classroom based teacher developed
- (5) other

```
FOR ENTIRE  POPULATION
SUM             94.850
MEAN             1.054
STD DEV          1.547
VARIANCE         2.393
N              (    90)

VARIABLE    MEATYP1

CODE                1.

SUM              3.870
MEAN             0.967
STD DEV          0.692
VARIANCE         0.478
N              (     4)

CODE                2.

SUM             40.990
MEAN             1.242
STD DEV          0.957
VARIANCE         0.916
N              (    33)

CODE                5.

SUM             49.990
MEAN             0.943
STD DEV          1.862
VARIANCE         3.409
N              (    53)

  TOTAL CASES =         90
```

Table 50
Inquiry Outcome Effect Sizes Across MSMET1

Measurement method

(1) multiple-choice
(2) semantic differential
(3) Likert
(4) questionnaire
(5) observation
(6) interview
(7) Q-sort
(8) other

```
FOR ENTIRE  POPULATION
SUM              92.340
MEAN              1.038
STD DEV           1.548
VARIANCE          2.396
N           (       89)

VARIABLE     MSMET1

CODE                 1.

SUM               7.640
MEAN              0.695
STD DEV           0.553
VARIANCE          0.306
N           (       11)

CODE                 3.

SUM               3.920
MEAN              0.653
STD DEV           0.555
VARIANCE          0.308
N           (        6)

CODE                 5.

SUM              48.570
MEAN              1.056
STD DEV           1.954
VARIANCE          3.819
N           (       46)

CODE                 8.

SUM              32.210
MEAN              1.239
STD DEV           1.116
VARIANCE          1.245
N           (       26)

   TOTAL CASES =         90
 MISSING CASES =          1 OR    1.1 PCT.
```

Table 51
Inquiry Outcome Effect Sizes Across TMMEA1

Time of measurement

(1) before treatment
(2) after treatment
(3) pre-post
(4) delayed
(5) other

```
FOR ENTIRE POPULATION
SUM                  94.850
MEAN                  1.054
STD DEV               1.547
VARIANCE              2.393
N                  (     90)

VARIABLE      TMMEA1

CODE                     2.

SUM                  40.960
MEAN                  1.024
STD DEV               2.097
VARIANCE              4.397
N                  (     40)

CODE                     3.

SUM                  49.590
MEAN                  1.078
STD DEV               0.948
VARIANCE              0.899
N                  (     40)

CODE                     5.

SUM                   4.300
MEAN                  1.075
STD DEV               0.569
VARIANCE              0.324
N                  (      4)

   TOTAL CASES =          90
```

Table 52

Inquiry Outcome Effect Sizes Across CALC01

Calculation of effect size

(1) directly from reported data or raw data (means & variations)
(2) reported with direct estimates (ANOVA, t, F)
(3) directly from frequencies reported on ordinal scale (probit, X^2)
(4) Backwars from variance of means with randomly assigned groups
(5) nonparametrics (other than #3)
(6) guessed from independent sources (test manuals, other students using the same test, conventional wisdom)
(7) estimated from variance of gain scores (correlation estimating)
(8) probability levels
(9) pre-test data used as a control group

```
FOR ENTIRE POPULATION                      CODE                  5.
SUM            94.850
MEAN            1.054                      SUM                0.980
STD DEV         1.547                      MEAN               0.980
VARIANCE        2.393                      STD DEV            0.0
N          (      90)                      VARIANCE           0.0
                                           N           (         1)

VARIABLE   CALC01                          CODE                  8.

CODE               0.                      SUM                2.600
                                           MEAN               0.650
SUM             0.640                      STD DEV            0.081
MEAN            0.640                      VARIANCE           0.007
STD DEV         0.0                        N           (         4)
VARIANCE        0.0
N          (       1)

CODE               1.                      CODE                  9.

SUM            62.610                      SUM                6.100
MEAN            1.079                      MEAN               0.871
STD DEV         1.841                      STD DEV            0.400
VARIANCE        3.390                      VARIANCE           0.160
N          (      58)                      N           (         7)

CODE               2.                        TOTAL CASES =          90

SUM            21.920
MEAN            1.154
STD DEV         0.986
VARIANCE        0.972
N          (      19)
```

Table 53
Analysis of Variance
Inquiry Outcome Effect Sizes Across CALC01

```
SOURCE             SUM OF SQUARES    D.F.   MEAN SQUARE       F        SIG.
BETWEEN GROUPS              1.290       5         0.258    0.102     0.9914
   LINEARITY                0.686       1         0.686    0.272     0.6033
   DEV. FROM L              0.604       4         0.151    0.060     0.9932
                   R    =-0.0567     R SQUARED    = 0.0032
WITHIN GROUPS             211.683      84         2.520
                   ETA = 0.0778     ETA SQUARED = 0.0061
```

Table 54
Inquiry Outcome Effect Sizes Across MEANS01

Source of means

(1) unadjusted post-test
(2) covariance
(3) residual gains
(4) pre-post differences
(5) other

```
FOR ENTIRE  POPULATION
SUM               92.250
MEAN               1.073
STD DEV            1.580
VARIANCE           2.497
N               (     86)

VARIABLE     MEANS01

CODE                  1.

SUM               54.090
MEAN               1.002
STD DEV            1.825
VARIANCE           3.332
N               (     54)

CODE                  4.

SUM               31.570
MEAN               1.315
STD DEV            1.188
VARIANCE           1.411
N               (     24)

CODE                  5.

SUM                6.590
MEAN               0.824
STD DEV            0.387
VARIANCE           0.150
N               (      8)

   TOTAL CASES =          90
 MISSING CASES =           4 OR    4.4 PCT.
```

Table 55

Inquiry Outcome Effect Sizes Across SIG01

Significance

(1) p ≤ .005 (4) p ≤ .10
(2) p ≤ .01 (5) p > .10
(3) p ≤ .05

```
FOR ENTIRE  POPULATION
SUM               88.970
MEAN               1.047
STD DEV            1.577
VARIANCE           2.486
N               (     85)

VARIABLE    SIG01

CODE                  1.

SUM                9.890
MEAN               1.236
STD DEV            0.685
VARIANCE           0.469
N               (      8)

CODE                  2.

SUM               40.530
MEAN               1.842
STD DEV            2.586
VARIANCE           6.686
N               (     22)

CODE                  3.

SUM               27.060
MEAN               1.230
STD DEV            1.095
VARIANCE           1.199
N               (     22)

CODE                  4.

SUM                1.350
MEAN               0.675
STD DEV            0.247
VARIANCE           0.061
N               (      2)

CODE                  5.

SUM               10.140
MEAN               0.327
STD DEV            0.535
VARIANCE           0.287
N               (     31)

  TOTAL CASES =        90
MISSING CASES =         5 OR    5.6 PCT.
```

Table 56
Inquiry Outcome Effect Sizes Across COUNTRE

The number of variables (TRTY101-TRTY110)
used to describe each treatment.

```
FOR ENTIRE  POPULATION
SUM            94.850
MEAN            1.054
STD DEV         1.547
VARIANCE        2.393
N           (     90)

VARIABLE    COUNTRE

CODE               1.

SUM            34.190
MEAN            1.266
STD DEV         2.357
VARIANCE        5.557
N           (     27)

CODE               2.

SUM            35.990
MEAN            0.782
STD DEV         0.980
VARIANCE        0.961
N           (     46)

CODE               3.

SUM            10.880
MEAN            0.989
STD DEV         0.780
VARIANCE        0.609
N           (     11)

CODE               4.

SUM             9.790
MEAN            1.958
STD DEV         0.658
VARIANCE        0.433
N           (      5)

CODE               6.

SUM             4.000
MEAN            4.000
STD DEV         0.0
VARIANCE        0.0
N           (      1)
```

Table 57
- Inquiry Outcome Effect Sizes Across TRTY101-110

Treatment type: (Use 1-10 variables as appropriate)

Organization

(1) competency based program
(2) field based program
(3) ongoing institute
(4) summer institute
(5) workshop
(6) methods course
(7) science course
(8) science course designed for teachers
(9) minicourse
(10) units of study
(11)

Instructional Exposure, strategy

(12) general
(13) traditiional
(14) inquiry
(15) discovery
(16)

Instructional Exposure, mode

(17) verbal
(18) mixed
(19) concrete
(20)

CODE	MEAN	STD DEV	N
2.	0.6000	0.4420	4)
3.	0.6350	0.9405	2)
4.	0.2500	0.0	1)
5.	2.1987	4.2930	6)
6.	1.0800	1.2538	11)
8.	0.6467	0.6618	6)
10.	1.9422	1.2671	9)
12.	0.9817	1.4220	18)
13.	0.0450	0.2475	2)
14.	0.4783	0.5343	6)
15.	0.4833	0.3707	3)
17.	0.1000	0.0	1)
18.	0.3867	0.9471	9)
19.	0.8283	0.6715	12)

Table 53 (cont'd)

Instructional exposure, interaction

(21) direct
(22) mixed
(23) indirect
(24)

Instructional exposure, source of structure

(25) student self-directed
(26) student interacting with materials and/or teacher
(27) teacher
(28) criterion referenced

Instructional exposure, focus of control

(29) student self-directed
(30) student and teacher working together
(31) teacher directed
(32) mix, part student, part teacher

Technique

(33) I A feedback
(34) instructional strategy feedback
(35) wait-time analysis
(36) questioning analysis
(37) micro-teaching peers
(38) micro-teaching students
(39) modeling strategy
(40) behavior coding training (eg IA) or strategy analysis
(56) interview training
(57) question construction
(58) persuasive communication

Technology

(41) audio technology
(42) video technology
(43) computer technology
(44) programmed material (a-t)
(45) print material

CODE	MEAN	STD DEV	N
25.	0.0275	0.6501	4)
26.	2.2050	0.4313	2)
2[illegible].	0.6700	0.0	1)
29.	1.1729	1.0317	7)
31.	1.4400	0.0	1)
34.	2.9000	0.0	1)
35.	4.0000	0.0	1)
33.	1.3300	0.0	1)
34.	0.9286	0.9488	7)
36.	1.4260	1.4360	5)
37.	0.6400	0.0	1)
38.	0.5150	0.4031	2)
39.	1.3846	1.0258	13)
40.	1.5443	0.7682	7)
57.	0.9025	0.2052	4)
58.	2.7300	0.0	1)
41.	1.0375	0.2546	4)
42.	1.5562	1.2937	8)
44.	1.6767	0.9182	6)
45.	1.4000	0.0	1)

Table 5-8
Pearson Correlation Coefficients
Inquiry Outcome Effect Sizes (EFSIZE01)
with Selected Independent Variables
(Coefficient/ (cases) /Significance)

coefficient
# cases
significance

FORM	-0.2851 (90) P=0.006	VALID	-0.1140 (86) P=0.296	NTREAT1	-0.0928 (90) P=0.384
TYPE	-0.1507 (88) P=0.161	RATE	0.0752 (90) P=0.481	SPONS1	-0.1486 (9) P=0.703
OUTUN	-0.1182 (90) P=0.267	DATPRE	0.0070 (86) P=0.949	TIME1	0.1520 (90) P=0.153
ASSIGN	0.0434 (88) P=0.686	CHAR	0.0471 (89) P=0.661	SITTRET1	-0.0533 (87) P=0.624
ASINUM	-0.0296 (89) P=0.783	SAMP	-0.1449 (89) P=0.175	EXTTRET1	0.0053 (90) P=0.960
ANAL	-0.0278 (90) P=0.794	FEMALE	0.0789 (19) P=0.748	LEUTRET1	0.0448 (90) P=0.675
PER	-0.0887 (89) P=0.408	EDUBACK	0.0601 (65) P=0.406	DUR1	-0.1919 (87) P=0.075
TUNIT	-0.0200 (86) P=0.855	MAJOR	-0.1078 (23) P=0.625	CONTACT1	0.0188 (84) P=0.865
TCOR	0.0611 (81) P=0.588	MINOR	99.0000 (5) P=*****	FID1	-0.0336 (89) P=0.755
STUASSIG	-0.3364 (19) P=0.159	LEVEL	0.1405 (32) P=0.443	CONTYPE1	99.0000 (37) P=*****
ASINUMS	-0.5316 (13) P=0.062	DEGREE	0.1644 (75) P=0.159	NOUT1	-0.1212 (88) P=0.261
ANAGSTU	-0.4332 (16) P=0.094	EXPT	0.0408 (79) P=0.721	CRIOUT1	0.0606 (90) P=0.570
SUNIT	0.2567 (18) P=0.304	STUSAMP	-0.4948 (16) P=0.051	MEATYP1	-0.0808 (90) P=0.449
SCOR	0.0315 (21) P=0.892			INTENT1	-0.0457 (90) P=0.669

Table 53 (cont'd)

```
MSMET1        0.1178
             (    89)
             P=0.272        IORELI1        0.3531
                                          (    37)
REL1          0.3341                      P=0.032
             (    38)
             P=0.040        FORREL1        0.3066
                                          (    14)
RELM1        -0.1697                      P=0.286
             (    18)
             P=0.501        FORIOR1        0.1724
                                          (    30)
VALEST1      99.0000                      P=0.362
             (    26)
             P=*****        CALCO1        -0.0567
                                          (    90)
TMMEA1        0.0140                      P=0.595
             (    90)
             P=0.896        INSTO1        -0.0294
                                          (    90)
                                          P=0.783

PREPOS1       0.0920        MEANSO1        0.0442
             (    43)                     (    86)
             P=0.558                      P=0.686

REACT1        0.0572        SIGO1         -0.3476
             (    88)                     (    65)
             P=0.596                      P=0.001

CEIL1        99.0000
             (    41)        COUNTRE        0.1146
             P=*****                      (    90)
                                          P=0.282
```

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Teacher age (026)	-.28 -.01 .25 .12			.01 -.10 -.10 .10	0. -.24	-.01						.20 .16 .24 .13	-.40	-.23 .15 -.17						-.23				.14 -.10	.06 .16 -.30 .26 -.13	
# education courses (027)	.16 .58 -.08			-.49	.53	.08						-.45 .35 .28 -.42	.40	.28 -.21 .45						.52	.17			.02		.02
# science courses (028)	-.2[illegible] .22			.06 -.24	.06 .22	-.07						-.22		.21						-.28	.01			-.03	.06 .06 .27 -.48	-.08
# biology courses (029)	-.12																				.04				.07	-.04
# chemistry courses (030)	-.06																									
# physics courses (031)	-.05																									
GPA (032)	.17 .16																								.03 .41 .50	

495
Table 59

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Student-teaching grade (033)	.10 .57																									
Teaching biology (034)																									.03	
Teaching physics (036)																										
Teaching (037)	.51 .15	.36		.09 -.08 -.09 .19 .18	.12 .06 .07 -.21	.03 .03					-.19	.18 .13 .42 .17	-.37	-.47 .31 -.31			-.09			.05 .24	-.11			.08	.31 .35 .02 .57	-.16
Teaching science (038)	.32																									
Teaching specialization (039)																										
Educational background (040)				-.11 -.05								.14 .01 .03	-.31	-.08 .14					.12						-.13	
Knowledge (041)	-.03			.25 -.49	.50 .39	.25					.28	0.	.31	.26 .45	.29						.17					.29 .24

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Academic institute (043)																				.43				.04	.04 .37	
Teacher gender (044)		.14 .10 .11		.03 .32 .04	.02 .10 .07 .11	.02	-.06									-.15	.09	.16 .16	-.06	.17 .06			.14		.12	
Teacher race (045)	-.39																									
Exhibitionism (049)	.29																									
Autonomy (050)																										
Heterosexuality (051)																										
Enthusiasm (052)					.03																			.21		
Self-concept (053)					.07																			.20		
Self-actualization (054)																										

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Reflectivity (056)		.17 -.12 .29		.10 -.05 -.48	-.64 -.46 -.60	.31	.17	-.19	-.24	-.50		-.07		-.35		.12 .52	-.31				.21				.41 -.08	
Physical-self (057)																										
Personal-self (058)																										
Achievement (059)		.80		-.66	-.69	.03 .65						-.10		-.16		.48									.15 .14 .28 .09 .46	
Dominance (060)		.29		.29	-.07	-.53						-.41		-.13		-.29					-.23				-.37 .02	-.27
Self-sufficiency (061)	.01	.52		-.54	-.57 .33	.13						-.65		.07		.12								.06	-.21 .06	
Adventurousness (062)					.11																			.04		
Confidence (063)	.07				-.11																			.14	.12 .08	

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Receptivity (064)		.70		-.48	-.50	.02 .52						-.19		.02		.24									.12 -.09 .23 .61	
Deference (065)																										
Change (066)																										
Objectivity (067)		-.62 .12		-.05 .36 .14 .07	.71 .20		-.24	-.21	.62	.07						-.12	.21				-.24					
Adaptability (068)	.03 -.02 .03	-.38 .52		.52 .79	-.24 -.26 -.22		.40	-.60	.40	-.36						-.52	.07				-.14			.14	.12 .07	
Realism (069)		.70		-.63 .56 .08	-.86	.23						-.59		-.22		.49								.12	.10 .04	
Nurturance (070)																										
Affiliation (071)		-.26 .05		.10 .57	.26 -.14		-.14	-.05	.43	.19						-.05	.24				-.26					

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Outgoingness (072)	.03 .29			-.21 -.13	.07																			.02		
Order (074)	.13																									
Endurance (075)	.92																									
Conscientiousness (076)	.17			-.18	-.40 .10	.05 .49						-.10		.30		.33								.12	.11 .05 -.16 -.12	
Planfullness (077)																										
Intellectuality (078)						.05																			.10 .28 .41 .39	
Intelligence (079)					.09																			.25		
Analytic orientation (080)																										
Creativity (081)	.19																									

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Imagination (082)	.10				.09																			.04		
Motility (083)		-.02 .19		.19 .21	.12 .08		-.05	.07	.29	.57						-.19	.52				.02					
Stability (084)		.17 -.40		-.57 .07	.50 .25 .07		-.21	.40	-.29	-.17						.40	-.64				-.79			.25		
Restraint (085)		.19 -.14 .72		-.29 -.71 -.62	.14 .40 -.66	.71	-.02	.29	-.48	-.05		-.18		.14		.14 .54	-.24				.19				.12 .04	
Anxiety (086)					.09																			.19		-.03
Aggression (087)	.01				.16																			.04		
Abasement (088)																										
Leadership (089)	.74	-.74 .17		-.07 .26	.62 .28		-.19	-.14	.43	-.10						-.17	.10				-.07					
Ego achievement (090)																									.10 .07	

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Forthrightness (091)																								.03		
Conservatism (092)	-.08				-.20																			.13		
Aesthetic values (093)																										
Social values (094)	.10 -.04																									
Theoretical values (095)																									.08 -.41	
Technological values (096)																										
Teaching attitude (097)																								.27		
Science attitude (098)				.16 .24		.19					.16		.19	.28	.26							.11				.24
Science teaching (099)				.46 .17	.06	.80													.26			.30				
Specific subject (100)																										

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Moral and ethical self (121)	-.13 -.05																									
Family-self (122)																										
Social-self (123)																										
Intellectually independent (124)																										
Friendliness (125)		.19 .29		.45 .40	-.69 -.36		.57	-.05	-.48	-.50						-.29		-.31				.05				
Succorance (126)																										
Intellectually-oriented (127)	-.11 -.21																									
Dogmatism (128)				-.28 -.02 .06																				.80	-.32	
Religious values (129)																										

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
TEACHER BEHAVIOR(CONT.)

	Teaching effectiveness T01	Interrelationship between students & teacher T02	Similarity of cognitive patterns T03	Teacher orientation T04	Teacher-student T05	Student T06	Verbal T07	Non-verbal T08	Congruent T09	Contradictory T10	Questioning T11	Low-level-factual T12	Flexible-clarifying T13	High-complex T14	Wait time T15	Discipline T16	Use of objectives T17	Teacher aura T18	Type of curriculum T19	Use of methods T20	Content development T21	Method of teaching T22	Attitude toward other teaching staff T23	Achievement tests T24	Attitudes toward curriculum T25	Other T26
Economic values (130)																									.09 .11 -.41 -.61	
Political values (131)																										
Cognitive preference (132)		.01		.06		-.15					-.06					-.11										-.01 .01
Masculinity (133)		-.14 -.43		-.33 .33	-.14 .57		-.38	.19	.17	-.12						.43	-.26				-.52					
Use of specific curriculum (134)					.07												.03			.10						
Cognitive pattern similarity (135)																										
Cognitive level similarity (136)																										

Table 60

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Teacher age (026)	.50	-.14	.14 .21 -.01		.12								.12	.15		.26							
# education courses (027)	-.62	.47	.04 -.08 .02													-.01							
# science courses (028)	-.02 -.14	.25	.48 .60 .18 -.08 -.12 .06 .08		.05								.06 .29	.05		.39 .23 .02 .24 .16			.06				
# biology courses (029)			.17 .60 .60 -.03		.22								-.10	.37		.33							
# chemistry courses (030)			.67										.18										.13
# physics courses (031)			.42										.18 -.05				.18 .26 -.16						
GPA (032)																							

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME (CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Student teaching grade (033)																							
Teaching biology (034)			.01		.08								.03			.12 .13 .25 .24							
Teaching physics (036)			.27										.12 .16				.20 .03 .19						.20
Teaching (037)	.33 -.06	-.07	.13 .97 -.09 .13 .22 0.		.22								-.08 .07	.05		.30 -.01		-.12					
Teaching science (038)																							
Teaching specialization (039)																							
Educational background (040)			.12																				

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Knowledge (041)	-.39	.49	-.16 -.04 .16 .17										-.15 .26 -.17 -.29				-.13 .10 -.28	-.13					.06 -.11
Academic institute (043)			.07 .26										-.04										
Teacher gender (044)			.11 .02 .06 -.03												.25 .11 .13 .12 -.03 .02		-.04						
Teacher race (045)																							
Exhibitionism (049)			0.		.07					.17	0.		-.11 -.09 .01		.04								
Autonomy (050)			.08										-.23 -.06										
Heterosexuality (051)			.42 .37										.32 .49 -.17 -.21				-.15						-.35 .11

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Enthusiasm (052)					-.12					-.16	-.05		-.14			-.17							
Self concept (053)													-.03 -.37					-.19					
Self actualization (054)			.08 .67 .64		.13								-.05			.06 -.28	.10						
Reflectivity (056)													.02			.05	.15						
Physical-self (057)													-.01										
Personal-self (058)													0.										
Achievement (059)			-.15										-.12 -.34			-.38							-.30
Dominance (060)			0.										-.08 0.			-.44	.27						-.28
Self sufficiency (061)																-.36							
Adventurousness (062)																							

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PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME (CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Confidence (063)					-.12					-.02	.05		-.07			-.03							
Receptivity (064)																-.44							
Deference (065)			.13										-.39 .17 .34										
Change (066)			-.19										-.29 .02										
Objectivity (067)																							
Adaptability (068)																							
Realism (069)																-.56							
Nurturance (070)			-.14										.18 -.10										
Affiliation (071)			-.08		-.02					-.09	.18		-.02 .17 -.30			.05							

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Outgoingness (072)					-.02					-.05	.08		-.10			-.06							
Order (074)			-.10										-.14 .18										
Endurance (075)			.12		.07					-.13	.07		-.04 .05 .29			.01							
Conscientiousness (076)																-.52							
Planfullness (077)					.01					-.14	.02 -.13		-.05			-.14							
Intellectuality (078)																							
Intelligence (079)																							
Analytic orientation (080)			.09		.41								.07			.19							
Creativity (081)																							

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Imagination (082)																							
Motility (083)																							
Stability (084)																							
Restraint (085)																-.35							
Anxiety (086)					-.05					-.01	-.10		.03			.06							
Aggression (087)			.13										.07 0.			.38							
Abasement (088)			.02										.45 -.05										.41
Leadership (089)					.09					.02	.01		-.19			-.07							
Ego-achievement (090)																							
Forthrightness (091)																							

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Conservatism (092)					.02					-.11	.10		.09			-.01							
Aesthetic values (093)			.13		-.01					.05	-.12		0. .03 -.02										
Social values (094)			.15		.04					-.05	.08		-.02 -.40 .02 .16			.05			.32				.33
Theoretical values (095)			-.24		-.19					.02	.03		.33 -.43 -.37								.32		
Technological values (096)																				.32			
Teaching attitude (097)																							
Science attitude (098)			.17 .04		.24								-.29	.14		.11 .22 .02 .20 -.05	-.09	-.21					.06
Science teaching (099)			.15		.27									.11		.17 .05							.06

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME(CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Specific subject (100)																.24	-.20						
Moral and ethical self (121)													.02										
Family-self (122)													-.06										
Social-self (123)					-.05					-.08	.03		-.01 .08			.09							
Intellectual independence (124)																							
Friendliness (125)																							
Succorance (126)			-.04		-.14					-.08	-.09		-.06 .51 -.09 -.08			-.07							
Intellectually-oriented (127)					-.08					-.01	-.02					.06							
Dogmatism (128)					-.11					-.15	-.09					-.06							.77

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS
STUDENT OUTCOME (CONT.)

	Student cognitive low S01	Student cognitive high S02	Student cognitive mixture S03	Student cognitive preference S04	Student critical thinking S05	Student spatial reasoning S06	Student logical thinking S07	Student creativity S08	Student decision making S09	Student problem solving S10	Student curiosity S11	Student response behavior S12	Student process skills S13	Student methods in science S14	Student self concept S15	Student affective science S16	Student affective course S17	Student affective method S18	Student social values S19	Student technological values S20	Student theoretical values S21	Student psychomotor S22	Student other S23
Religious values (129)			-.21		.15					-.02	.09		.15 -.08 .03			.10							
Economic values (130)			.32							-.07	-.04		.02 .19 .19			-.09							
Political values (131)			-.03		-.02					.06	.02		-.27 -.07 -.17			-.14							-.29
Cognitive preference (132)			.40	.14																			
Masculinity (133)			.60 .15																				
Use of specific curriculum (134)			.07																				
Cognitive pattern similarity (135)			.23 .30																				
Cognitive level similarity (136)			.12																				

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SCIENCE TEACHER CHARACTERISTICS BY TEACHER BEHAVIOR AND BY STUDENT OUTCOME: A META-ANALYSIS OF RESEARCH

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INTRODUCTION

Teachers are perceived as playing a primary role in a student's learning process. To adequately perform this role, certain teacher characteristics are potentially more valuable for encouraging student learning. In an attempt to discern those characteristics related to student learning and teacher behavior in the science classroom, numerous studies have been conducted. This chapter reports an integration of empirical research on the relationship between science teacher characteristics and (1) teacher behavior, and (2) student outcome, through the statistical procedure of meta-analysis.

This meta-analysis pertains to studies of the relationship between science teacher background characteristics (e.g., gender, coursework taken, personality traits, etc.) as the independent factor, and either (1) their behavicr in the classroom (e.g., questioning style, teaching orientation, etc.), or (2) student outcomes (e.g., achievement, attitude toward science, etc.) as the dependent factor. The subjects included within the studies coded were teachers in science classes, ranging from kindergarten through twelfth grade, located in the United States, and in some cases the students of these teachers. In some instances, non-certified student teachers and probationary teachers were included within the teacher sample.

DEFINITION OF FACTORS

Independent Factor--Teacher Characteristics

The science teacher characteristics factor was partitioned into a background information section and a personality section. The background section contains information pertaining to teacher sex, IQ, level of knowledge specific to a given topic, age, level of education and teaching experience. The personality section contains 70 variables that may be loosely grouped under the headings of positivism, self-concept, independence, receptivity, friendliness, motivation and direction, intellect, social behavior, values, and attitudes. The personality variables listed in this section were gleaned from several personality theories as well as from the numerous measurement instruments reported in the studies coded.

Dependent Factors - Teacher Behaviors

(01) Teaching effectiveness, efficiency--The ability to produce desired change within the classroom as perceived by students and principals.

(02) Interrelationship between students and teachers--The rapport perceived by students and outside observers to exist between students and the teacher. (e.g. use of democratic practices, personal ease with students)

(03) Similarity of cognitive patterns--The similarity between students and the teacher in the way they conceptualize or approach tasks. Cognitive pattern or cognitive style is the distinctive way of perceiving, feeling, making and problem solving that constitutes part of an individual's personality. (although a measure of personality, this relationship was classified a teaching behavior as it measured an interaction between the teacher and students in the classroom.)

(04) Teacher orientation--The emphasis given during class by the teacher to lecture, information-giving, and teacher talk.

(05) Teacher-Student orientation--The emphasis given in class by the teacher to information-seeking and discussion.

(06) Student orientation--The emphasis given in class time by the teacher to inquiry and student talk.

(07) Form of expression-Verbal--The use of verbal reasoning within the class.

(08) Form of expression-Non-verbal--The use of demonstration, facial expressions, and body language within the class.

(09) Form of expression-Congruent--The degree to which the teacher's statements are in agreement with those of the students.

(10) Form of expression - Contradictory--The degree to which the teacher's statements are in disagreement with those of the students.

(11) Questioning behavior--The amount of time spent by the teacher in the classroom questioning students.

(12) Low-level, factual, rhetorical--A measure of the emphasis given in class to questioning students using low cognitive level questions.

(13) Flexible, clarifying--A measure of the emphasis given in class to questioning students to clarify presented material.

(14) High, complex, associative, critical thinking--A measure of the emphasis given in class to questioning students using high cognitive level questions.

(15) Wait time--The amount of time measured between the teacher asking students a question and a student responding to the question.

(16) Discipline, classroom management--A measure of the degree to which the class is under the control of the teacher.

(17) Use of objectives, directed motivation--The degree to which the teacher sets goals and objectives and makes them explicit to the students.

(18) Teacher aura--The degree to which the teacher is perceived by the students to be responsible, knowledgeable, stimulating and interesting.

(19) Type of curriculum--The degree to which the curricula presented within the classroom is progressive as opposed to traditional.

(20) Use of methods, materials--The degree to which laboratory equipment and various teaching materials are used within the classroom.

(21) Content development--The degree to which course content is developed.

(22) Method of teaching--The degree to which the method of teaching presented in the classroom is progressive as opposed to traditional.

(23) Attitude toward other teaching staff--The degree to which the teacher displays a positive attitude toward other teaching staff.

(24) Achievement tests of teaching behaviors and science processes--Scores on tests designed to assess the degree to which a teacher possesses a positive attitude toward teaching and a sufficient amount of science process skills.

(25) Attitudes, expectations of specific curriculum--The degree to which the teacher possesses a positive attitude toward the specific curriculum considered within the study.

(26) Other--A conglomeration of teaching behaviors that could not be classified elsewhere:

1. Use of productive silence within the classroom

2. The character of classroom practices measured on a scale running from text through teacher to child.
3. The degree to which a teacher displays a positive attitude toward scientists.
4. The proportion of classtime spent by the teacher within space defined as belonging to students.

Dependent Factors-
Student Outcomes. The student outcome criteria deal with assessment of various student products, abilities, attitudes, and personality characteristics.

(01) *Cognitive Low*--A measure of student abilities at the lower levels of Bloom's taxonomy of cognitive development (knowledge, comprehension).

(02) *Cognitive High*--A measure of student abilities at the higher levels of Bloom's taxonomy of cognitive development (application, analysis, synthesis, evaluation).

(03) *Cognitive Mixture*--A score on a test of general achievement.

(04) *Cognitive Preference*--The desired approach to learning and thinking an individual possesses. A measure of the preferred method of learning and thinking. Included within this category are measures of cognitive control with field dependence on the lower end of the scale and field independence at the higher end of the scale, and cognitive tempo with reflectivity at a higher value on the scale in comparison to impulsivity.

(05) *Critical Thinking*--The score on an instrument assessing a student's inference, recognition of assumptions, deduction, interpretation, and evaluation of arguments in addressing issues.

(06) *Spatial Reasoning*--A measure of the student's ability to think and reason using visual imagery.

(07) Logical Thinking--A measure of the student's ability to use syllogisms and both deductive and inductive thinking and reasoning.

(08) Creativity--A measure of the student's ability to think divergently and to produce a large number and variety of original responses to a stipulated stimulus situation.

(09) Decision Making--A measure of judgment and decision making abilities.

(10) Problem Solving--A measure of the ability to formulate creative solutions to problems.

(11) Student Curiosity--The amount of interest a student shows toward a subject.

(12) Response Behavior--The amount of verbal or behavioral response shown by students to a teacher's questioning.

(13) Process Skills--A measure of a student's ability to grasp the essence of scientific process.

(14) Methods in Science--A measure of the ability to use correct scientific methods in comprehending concepts.

(15) Self Concept--A measure of the degree of responsibility, sense of ascendency and autonomy the individual perceives himself or herself to possess.

(16) Affect Toward Science--The degree to which a student possesses a fondness or liking of science.

(17) Affect Toward Course--The degree to which a student possesses a fondness or liking of a specific course or subject.

(18) Affect Toward Method--The degree to which a student possesses a fondness or liking of a specific teaching method.

(19) Social Values--The degree to which a student possesses an altruistic or philanthropic view of life.

(20) Technological Values--The degree to which a student possesses a systematic knowledge of the industrial arts.

(21) Theoretical Values--The degree to which a student places importance on the process of discovering truth and of ordering and systematizing knowledge.

(22) Psycho Motor--The degree to which a student displays coordination and dexterity.

(23) Other--Student outcomes that could not be classified under previous categories (e.g., pupil activity (tinkering), preference for science activity-affective activities, diversity of problem selection).

METHODS

Data Sources

The studies coded came from three sources: dissertations, journal articles, and unpublished articles stored on microfiche. Of the 65 studies coded, 52 were dissertations, 11 were journal articles, and 2 were unpublished articles. Of the coded dissertations and journal articles, over 75% were studies performed within the time period of 1966-1975. The journal articles coded came from Journal of Research in Science Teaching and Science Education.

Procedure

An initial search for pertinent titles and abstracts was performed by the Colorado Science Education Meta-analysis Project staff.

Articles thought to be pertinent were then examined by the coder. Of 120 studies reviewed, 65 survived this initial filtering process and were considered for future analysis. Each coded study involved one or more criteria (dependent variables) related to teacher behavior or student outcome. Each criterion required a separate coding form. Included within the coding form were the following sections.

1. Identification of the study and the criterion (dependent variable).
2. A contextual description of the student sample.
3. Teacher background characteristics.
4. Description of the criterion.
5. Description of the reported statistic.
6. Report of the correlation of each of the reported teacher characteristics with the specific criterion as well as the level of reliability in measuring the independent variable.

In an attempt to arrive at a common scale for the studies reported for a specific criterion, all statistics were converted to Pearson product moment correlations. The methods used in converting statistics to Pearson r's may be found in Meta-analysis in Social Research (Glass, McGaw and Smith, 1981). A variable indicating the degree of manipulation of statistics to derive a correlation was also included.

In reading the description of a teacher characteristic reported in a study, instances were found where the underlying description of a trait was similar to one listed on the coding form, but given a different name. For example, persistence was coded under the teacher characteristic of endurance and general activity under mobility. Thus, where appropriate, the value of the trait was coded under the variable closest in meaning and a note made of the trait's name.

Analysis

The SPSS computer package was used to analyze the data. The data were first sorted into criteria that related to student outcome and criteria that related to teacher behavior. It was then sorted by the criterion variable within each of these two strata. The mean of the correlations, $\bar{r}$, for each specific criterion with a teacher characteristic was calculated.

RESULTS

The coded studies yielded 481 correlation coefficients between a teacher behavior and a teacher characteristic. When summarized within the matrix indicated above and cells having more than one correlation coefficient were averaged, there were 322 cells with a measure of the relationship between the given teacher behavior and teacher characteristic. In the case of the matrix correlation between teacher characteristics and student outcomes, there were 348 correlation coefficients and 242 cells in the matrix contained a value.

Two things in particular stand out upon first observing this matrix. One is the large number of cells that are based on data from only one study. So many different independent and dependent variables are involved that even though 65 studies were coded and each study on the average reported correlations between 13 pairs of variables, the data on any given pair is more often than not based on only one study.* A second characteristic of this extensive set of data is the relatively low absolute value of the correlation coefficients reported. Of the 322 cells containing data in the teacher characteristics by teacher behavior matrix, only 31 had a correlation coefficient that reached or exceeded .5 in absolute value. In the case of the teacher characteristics by student outcomes matrix, only six out of 242 such cells had a correlation coefficient that reached or exceeded .5. Recognizing that the square of the correlation coefficient indicates the proportion of variance that is accounted for in the relationship, it is clear that the small number of correlation coefficients exceeding .5 (and $r^2 = .25$) does not show the degree of association that many researchers probably hope to find when they embark upon their investigations.

The results of the analyses are reported in more detail within the following two sections pertaining to teacher behaviors and student outcomes.

Teacher characteristics and teacher behaviors

Those pairs of teacher characteristics and teacher behaviors having the highest degree of correlation are summarized in Table 1 which includes all correlations of .3 and larger based on two or more studies. It is apparent from the data cited earlier that the vast majority of relationships not reported in this table are missing both because of the low absolute value of the correlation coefficient and the fact that the data was based on only one study. Even so, this table should be looked upon as a listing of those relationships for which there is evidence of an association more so than an indicator of a lack of association. The data reported in Table 1 provides a basis for discussing the following relationships.

1. Teaching effectiveness is positively related to training and experience as evidenced by its correlation with the number of education courses taken, student teaching grade and experience teaching.
2. Teachers with a more positive attitude toward the curriculum they are teaching tend to be those with a higher grade point average,

more experience teaching, and a higher degree of intellectuality.

3. Better classroom discipline is associated with the teacher characteristics of restraint and reflectivity.
4. Higher level, more complex questions tend to be employed more often by teachers with greater knowledge and less experience teaching.
5. Orientation to teaching is related to a variety of teacher characteristics. A teacher orientation (i.e. emphasis upon lecture, information-giving and teacher talk) is positively associated with adaptability, affiliation, attitude toward science teaching, and friendliness, and is negatively associated with restraint. A teacher-student orientation (emphasis upon information-seeking and discussion) is negatively associated with reflectivity and friendliness but positively associated with objectivity, leadership, and knowledge. Finally, a student orientation (emphasis upon inquiry and student talk) is positively associated with the teacher characteristic of achievement.

Teacher characteristics and "effectiveness"

In order to summarize the teacher behavior classifications, an "effectiveness" scale was devised. The scale is comprised of the various teaching behaviors believed to represent positive classroom actions. Components of this scale are shown in Table 2. Teacher background characteristics were also collapsed as shown in Table 3. The correlation coefficients for these components were averaged for each of the classifications of teacher characteristics. The results are shown in Table 4.

The correlation coefficients obtained obviously are small, none reached .20. The largest of these small relationships are a positive one between effectiveness and the amount of training a science teacher has had, a positive relationship between effectiveness and a positive attitude toward teaching, science, etc., a positive relationship between effectiveness and temperament and a negative relationship between effectiveness and the values dimensions of personality.

Teacher characteristics and student outcomes

The associations between teacher characteristics and student outcomes are reported in Table 5. Not surprisingly, the degree of association between teacher characteristics and student outcomes is less than that between teacher characteristics and the more directly connected variables of teacher behavior. In view of this lesser degree of association, Table 5 was built from correlations of .15 or larger rather than the .3 criterion used in the previous instance. 1. Student achievement is positively related to the teacher characteristics of self actualization, heterosexuality, and masculinity. It is also related positively to the number of biology courses taken in the case of biology teachers, the number of science courses taken, and attendance at academic institutes. Finally, cognitive pattern similarity is positively related to achievement of the students.

2. With respect to the student outcome of process skills, there is a relationship with three teacher characteristics which may be viewed as having some commonality. These three are a negative relationship to achievement and self concept along with a positive relationship to abasement. Process skill outcomes of students also are positively associated with the number of science courses taken by teachers. Finally, there is a negative association between process skills and political and theoretical values on the part of teachers.

3. The third student outcome area, a positive affect toward science, is positively associated with the number of science courses taken by teachers and the number of years of teaching experience for biology teachers.

The table just discussed, Table 5 is based on the only three single student outcome variables having a correlation coefficient with some teacher characteristic of .15 or larger and based on two or more studies. As another way of summarizing the student outcome data, all of the student outcome variables were collapsed into three broader categories--cognitive, affective, and values. Table 6 lists the components of these categories. Table 7 shows the average correlations of these collapsed student outcome variables with the previously cited collapsed teacher characteristics.

Again, the relationships shown are low but there is some reason to take note of the following relationships.

1. Teacher age and student outcomes are positively associated.
2. Student outcomes are positively associated with the preparation of the teacher, especially science training, but also preparation in education and academic work generally.
3. In the realm of personality, the acquisition of values by students is positively related to a values orientation on the part of teachers. Similarly, an intellectual orientation on the part of teachers is positively related to cognitive student outcomes. Finally, efficiency is negatively related to affective student outcomes.
4. The greater the degree of self (e.g. self concept, self-actualization, autonomy, self sufficiency, etc.) possessed by the teacher, the lower the level of affect exhibited by the students (curiosity, self concept, etc.).

A further breakdown of student outcome by content of measure used and grade level of students assessed resulted in the following.

1. The relationship between teachers' training in science and cognitive student outcome is progressively higher in higher level science courses.
2. The negative relationship between degree of self possessed by the teacher and both cognitive and affective outcomes is more pronounced at both lower grade levels and in lower level courses.

Additional information

A more detailed presentation of the data acquired in this meta-analysis is reported in tables 8-13. They report the numbers of correlations in each of several categories, the average correlation in each category, and specific individual correlation coefficients reported in all of the coded studies.

IMPLICATIONS

The most striking overall characteristic of the results of this meta-analysis is the pattern of low correlations across the large number of variables involved. It must be noted, however, that there are some variations within this overall pattern depending upon what facet of teaching process is being addressed or what style of teach ing is under consideration. The results found have implications for hiring of teachers, for teacher education programs, and future research work.

While the hiring official seeking a new science teacher certainly must look beyond information on the teacher characteristics considered in this study, information on some of these characteristics certainly is worthy of inclusion in the decision-making process. This information will be of most value if one knows what type of student outcomes are being sought and what style of teaching is desired.

There is a relationship between teacher preparation programs and what their graduates do as teachers. Science courses, education courses and overall academic performance are positively associated with successful teaching.

The results of this meta-analysis also have implications for researchers, with the most obvious question being what future research should be pursued in this arena; there are several possible future steps. One possibility would be to extend the current meta-analysis. For example, more studies could be added to the data base through a more exhaustive search for applicable science studies or by adding other fields of study besides science. Any differences that might arise between subject fields would be of interest. In addition, if no major differences between fields is apparent, one could use the entire data base for drawing generalizations about relationships that are difficult to do at this stage because of the limited number of studies dealing with so many of the specific variables involved. A more extensive data base might make possible the use of some factor analytic approaches in interpreting the results. The researcher considering any of these steps, however, is still faced with the question of whether or note such an endeavor is worth the cost in view of the low correlations found thus far.

Another approach to be considered is to concentrate on some more limited facet of this large realm of teacher characteristics conducting the analysis on some more specific facet of it. For example, one might pick some particular style of teaching or category of student outcomes for a meta-analysis.

Another approach would be to undertake additional empirical research in this arena to generate more original data. The results of the meta-analysis reported here should be of value in identifying what facet of this topic might best be pursued. Whatever this rather limited topic would be, it is recommended that within that particular context the researcher should collect data on as many variables as possible. The multiplicity of interacting variables points to the need for this extensive data collection.

Table 3

TEACHER BEHAVIOR AND TEACHER CHARACTERISTIC CORRELATIONS*

Teacher Behavior	Teacher Characteristic	$\bar{r}$	Sr	n
Teaching Effectiveness	No. of Education Courses	.37	.32	3
	Student Teaching Grade	.34	.24	2
	Experience Teaching	.33	.18	2
Attitude Toward Curriculum	Grade Point Average	.31	.20	3
	Experience Teaching	.31	.20	4
	Intellectuality	.30	.12	2
Discipline	Restraint	.34	.20	2
	Relfectivity	.32	.20	2
Hi-Complex Questions	Knowledge	.36	.10	2
	Experience Teaching	-.34	.01	3
Teacher Orientation	Adaptability	.66	.14	2
	Restraint	-.54	.03	3
	Affiliation	.34	.24	2
	Attitude Toward Science Teaching	.32	.14	2
	Friendliness	.42	.02	2
Teacher-Student Orientation	Reflectivity	-.57	.08	3
	Friendliness	-.52	.16	2
	Objectivity	.46	.26	2
	Leadership	.45	.17	2
	Knowledge	.44	.06	2
Student Orientation	Achievement	.34	.31	2

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*Includes all correlations where $r \geq .30$ and $n \geq 2$.

Table 2

"Effective" Teaching Scale

Interrelationship Between Students and Teacher
*Teacher Orientation
Teacher-Student
Student
*Verbal
Non-Verbal
Questioning
*Low-Level Factual
Flexible Clarifying
High-Complex
Wait Time
Discipline
Teacher Aura
Type of Curriculum
Use of Methods
Content Development
Method of Teaching
Attitude Toward Other Teaching Staff
Achievement Tests
Attitudes Toward Curriculum

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*Indicates reversal of scale

Table 3
DEFINITION OF COLLAPSED TEACHER CHARACTERISTIC VARIABLES

Collapsed Variable	Variables Included
1. Teacher Gender	Teacher Gender
2. Teacher Age	Teacher Age
3. Science Training	Number of Science Courses Number of Biology Courses Number of Chemistry Courses Number of Physics Courses Knowledge
4. Education and Performance	Number of Education Courses Grade Point Average Student Teaching Grade Experience Teaching Biology Experience Teaching Physics Experience Teaching Experience Teaching Science
5. Academic Credit	Educational Background Academic Institute
6. Personal Characteristics	
a. Self	Autonomy Self Concept Self-Actualization Reflectivity Physical-Self Personal-Self Achievement Self-Sufficiency Confidence Abasement*
b. Social	Heterosexuality Dominance* Receptivity Deference Nurturance Affiliation Aggression* Leadership Ego Achievement* Forthrightness Family-Self Social-Self Friendliness Succorance Dogmatism*

*indicates scale reversed

Table 3 (continued)

Collapsed Variable	Variables Included
c. Intellectual	Intellectuality
	Intelligence
	Analytic Orientation
	Creativity
	Imagination
	Intellectual Independence
	Intellectually-Oriented
	Cognitive Preference
d. Values	Conservatism
	Aesthetic Values
	Social Values
	Theoretical Values
	Technological Values
	Moral and Ethical Self
	Religious Values
	Economic Values
	Political Values
e. Enthusiasm	Exhibitionism
	Enthusiasm
	Adventurousness
	Change
	Objectivity
	Adaptability
	Outgoingness
	Endurance
	Motility
f. Efficiency	Realism
	Order
	Conscientiousness
	Planfulness
g. Temperament	Stability
	Restraint
	Anxiety*
7. Attitudes	Toward Teaching
	Toward Science
	Toward Science Teaching
	Toward Specific Subject

Table 4

Correlation Between "Effective" Teaching And Various Background Characteristics

Predictor	$\bar{r}$	s_r	n
Teacher Gender	.04	.12	20
Teacher Age	-.07	.17	23
Science Training	.13	.23	28
Education and Performance	.08	.26	47
Academic Credit	.04	.19	14
Personality			
Self	.09	.35	49
Social	-.00	.35	52
Intellectual	-.07	.06	5
Values	-.15	.30	8
Enthusiasm	-.07	.30	43
Efficiency	.09	.36	25
Temperament	.19	.35	33
Attitudes	.15	.32	14

$\bar{r}$ = arithmetic mean of correlations collapsed

s_r = standard deviation of correlations collapsed

n = number of correlations collapsed

Table 5

Student Outcome and Teacher Characteristic Correlations*

Student Outcome	Teacher Characteristic	r	s_r	n
Achievement (Cognitive Mixture)	Self Actualization	.46	.27	3
	Heterosexuality	.40	.02	2
	Masculinity	.38	.22	2
	Number of Biology Courses	.34	.27	4
	Cognitive Pattern Similarity	.26	.04	2
	Number of Science Courses	.17	.25	7
	Academic Institute	.16	.10	2
Process Skills	Achievement	-.23	.11	2
	Self-Concept	-.20	.17	2
	Abasement	.20	.25	2
	Number of Science Courses	.18	.12	2
	Political Values	-.17	.08	3
	Theoretical Values	-.16	.34	3
Affect Toward Science	Number of Science Courses	.21	.12	5
	Experience Teaching Biology	.18	.06	4

*Includes all correlations where $r \geq .15$ and $n \geq 2$

Table 6

Definition of Collapsed Student Outcome Variables

Cognitive

1. Student Cognitive Low
2. Student Cognitive High
3. Student Cognitive Mixture
4. Student Cognitive Preference
5. Student Critical Thinking
6. Student Problem Solving
7. Student Process Skills

Affective

1. Student Curiosity
2. Student Self-Concept
3. Student Affective Science
4. Student Affective Course
5. Student Affective Method

Values

1. Student Social Values
2. Student Technological Values
3. Student Theoretical Values

Table 7

Correlation Between Collapsed Student Outcome Categories and Teacher Characteristics

Predictor/Outcome		Cognitive	Affective	Values	Total
Sex	$\bar{r}$	.04	.08		.07
	s	.06	.10		
	n	4	7		11
Age	$\bar{r}$	.13	.26		.15
	s	.20			
	n	7	1		8
Science training	$\bar{r}$	.19	.18	.06	.18
	s	.25	.17		
	n	24	9	1	34
Education & Performance	$\bar{r}$	.10	.12		.11
	s	.28	.13		
	n	23	11		34
Academic credit	$\bar{r}$	.10			.10
	s	.12			
	n	4			4
Personality Self	$\bar{r}$	-.00	-.12		-.03
	s	.26	.21		
	n	23	8		31
Social	$\bar{r}$	.02	-.14		.01
	s	.20	.22		
	n	42	15		57
Intellectual	$\bar{r}$	.15	.08		.13
	s	.19	.11		
	n	7	3		10
Values	$\bar{r}$	-.02	.01	.32	.01
	s	.17	.09		
	n	42	12	3	57
Enthusiasm	$\bar{r}$	-.03	-.02		-.03
	s	.11	.08		
	n	21	8		29

(continued on next page)

$\bar{r}$ = arithmetic mean of correlations
s = standard deviation of correlations
n = number of correlations in mean

Table 7 (Continued)

Correlation Between Student Outcome Categories and Teacher Characteristics

Predictor/Outcome		Cognitive	Affective	Values	Total
Personality (continued)					
Efficiency	$\bar{r}$	-.04	-.20		-.14
	s	.12	.26		
	n	6	4		10
Temperament	$\bar{r}$	.01	-.10		-.05
	s	.02	.23		
	n	3	3		6
Attitudes	$\bar{r}$	.10	.04		.06
	s	.21	.16		
	n	6	11		17

$\bar{r}$ = arithmetic mean of correlations
s = standard deviation of correlations
n = number of correlations in mean

Table 8

Number of Correlations with Teacher Characteristics

Reported for each Teacher Behavior Category

Teacher Behavior	Number of Correlations
1. Teaching Effectiveness	43
2. Student & Teacher Interrelationship	32
3. Similarity of Cognitive Patterns	0
4. Teacher Orientation	61
5. Teacher-Student Orientation	59
6. Student Orientation	22
7. Verbal Response	11
8. Non-Verbal Response	10
9. Congruent Statements	10
10. Contradictory Statements	10
11. Amount of Questioning	4
12. Low-Level Tactual Questions	25
13. Flexible, Clarifying Questions	6
14. High, Complex Questions	23
15. Wait Time	2
16. Discipline	20
17. Use of Objectives	13
18. Teacher Aura	2
19. Type of Curriculum	3
20. Use of Methods	9
21. Content Development	16
22. Method of Teaching	2
23. Attitude Toward Teaching Staff	1
24. Achievement Tests	24
25. Attitudes Toward Curriculum	61
26. Other	12
TOTAL	481

Table 9 - Average Correlation for each Teacher Characteristic by Teacher Behavior Combinations

Teacher Characteristic Teacher Behavior	$\bar{r}$	S_r	n
1. Teacher Age			27
a. Teaching Effectiveness	.02	.20	4
b. Teacher Orientation	-.02	.03	4
c. Teacher-Student Orientation	-.12	.12	2
d. Student Orientation	-.01	-	1
e. Low-Level Tactual Questions	.18	.04	4
f. Flexible-Clarifying Questions	-.40	-	1
g. High-Complex Questions	.08	.17	3
h. Use of Methods	-.23	-	1
i. Achievement Tests	.02	.12	2
j. Attitudes Toward Curriculum	-.01	.20	5
2. Number of Education Courses			18
a. Teaching Effectiveness	.37	.32	3
b Teacher Orientation	-.49	-	1
c. Teacher-Student Orientation	.53	-	1
d. Student Orientation	.08	-	1
e. Low-Level Tactual Questions	-.06	.38	4
f. Flexible-Clarifying Questions	.40	-	1
g. High-Complex Questions	.17	.28	3
h. Use of Methods	.52	-	1
i. Content Development	.17	-	1
j. Achievement Tests	.02	-	1
k. Other	.02	-	1
3. Number of Science Courses			18
a. Teaching Effectiveness	.00	.22	2
b. Teacher Orientation	-.09	.15	2
c. Teacher-Student Orientation	.14	.08	2
d. Student Orientation	-.07	-	1
e. Low-Level Tactual Questions	-.22	-	1
f. High-Complex Questions	.21	-	1
g. Use of Methods	-.28	-	1
h. Content Development	.01	-	1
i. Achievement Tests	-.03	-	1
j. Attitudes Toward Curriculum	-.02	.28	4
k. Other	-.33	.25	2
4. Number of Biology Courses			4
a. Teaching Effectiveness	-.12	-	1
b. Content Development	.04	-	1
c. Attitudes Toward Curriculum	.07	-	1
d. Other	-.04	-	1
5. Number of Chemistry Courses			1
a. Teaching Effectiveness	-.06	-	1
6. Number of Physics Courses			1
a. Teaching Effectiveness	-.05	-	1
7. Grade Point Average			5
a. Teaching Effectiveness	.16	.00	2
b. Attitudes Toward Curriculum	.31	.20	3
8. Student Teaching Grade			2
a. Teaching Effectiveness	.34	.24	2
9. Experience Teaching Biology			1
a. Attitudes Torward Curriculum	.03	-	1

Teacher Characteristics Teacher Behavior	$\bar{r}$	S_r	n
10. Experience Teaching			33
a. Teaching Effectiveness	.33	.18	2
b. Teacher-Student Interrelationship	.36	-	1
c. Teacher Orientation	.06	.12	5
d. Teacher-Student Orientation	-.00	.12	4
e. Student Orientation	.03	0	2
f. Amount of Questioning	-.19	-	1
g. Low-Level Tactual Questioning	.22	.11	4
h. Flexible Clarifying Questions	-.37	-	1
i. Hi-Complex Questions	-.34	.01	3
j. Use of Objectives	-.09	-	1
k. Use of Methods	.14	.10	2
l. Content Development	-.11	-	1
m. Achievement Tests	.08	-	1
n. Attitudes Toward Curriculum	.31	.20	4
o. Other	-.16	-	1
11. Experience Teaching Science			1
a. Teaching Effectiveness	.32	-	1
12. Educational Background			10
a. Teacher Orientation	-.08	.02	2
b. Low-Level Tactual Questions	.06	.06	3
c. Flexible-Clarifying Questions	-.31	-	1
d. High-Complex Questions	.03	.11	2
e. Types of Curriculum	.12	-	1
f. Attitudes Toward Curriculum	-.13	-	1
13. Knowledge			15
a. Teaching Effectiveness	-.03	-	1
b. Teacher Orientation	-.12	.37	2
c. Teacher-Student Orientation	.44	.06	2
d. Student Orientation	.25	-	1
e. Amount of Questioning	.28	-	1
f. Low-Level Tactual Questions	-.00	-	1
g. Flexible-Clarifying Questions	.31	-	1
h. High-Complex Questions	.36	.10	2
i. Wait Time	.29	-	1
j. Content Development	.17	-	1
k. Other	.26	.02	2
14. Academic Institute			4
a. Use of Methods	.43	-	1
b. Achievement Tests	.04	-	1
c. Attitudes Toward Curriculum	.20	.16	2
15. Teacher Gender			21
a. Student Teacher Interrelationship	.12	.02	3
b. Teacher Orientation	.13	.13	3
c. Teacher-Student Orientation	.08	.04	4
d. Student Orientation	.02	-	1
e. Verbal Behavior	-.06	-	1
f. Discipline	-.15	-	1
g. Use of Objectives	.09	-	1
h. Teacher Aura	.16	0	2
i. Type of Curriculum	-.06	-	1
j. Use of Methods	.12	.06	2
k. Attitude Toward Teaching Staff	.14	-	1
l. Attitude Toward Curriculum	.12	-	1

Teacher Characteristics			
Teacher Behavior			
16. Teacher Race			1
a. Teaching Effectiveness	-.39	-	1
17. Exhibitionism			1
a. Teaching Effectiveness	.29	-	1
18. Enthusiasm			2
a. Teacher-Student Orientation	.03	-	1
b. Achievement Tests	.21	-	1
19. Self-Concept			2
a. Teacher-Student Orientation	.07	-	1
b. Achievement Tests	.20	-	1
20. Reflectivity			22
a. Student & Teacher Interrelationship	.11	.17	3
b. Teacher Orientation	-.14	.25	3
c. Teacher Student Orientation	-.57	.08	3
d. Student Orientaiton	.31	-	1
e. Verbal Behavior	.17	-	1
f. Non-verbal Behavior	-.19	-	1
g. Congruent Statements	-.24	-	1
h. Contradictory Statements	-.50	-	1
i. Low Level Tactual Questions	-.07	-	1
j. High Complex Questions	-.35	-	1
k. Discipline	.32	.2	2
l. Use of Objectives	-.31	-	1
m. Content Development	.21	-	1
n. Attitudes Toward Curriculum	.16	.24	2
21. Achievement			13
a. Student & Teacher Interrelationship	.80	-	1
b. Teacher Orientation	-.66	-	1
c. Teacher-Student Orientation	-.69	-	1
d. Student Orientation	.34	.31	2
e. Low-Level Tactual Questions	-.10	-	1
f. High-Complex Questions	-.16	-	1
g. Discipline	.43	-	1
h. Attitudes Toward Curriculum	.22	.13	5
22. Dominance			11
a. Student & Teacher Interrelationship	.29	-	1
b. Teacher Orientation	.29	-	1
c. Teacher-Student Orientation	-.07	-	1
d. Student Orientation	-.53	-	1
e. Low-Level Tactual Questions	-.41	-	1
f. High, Complex Questions	-.13	-	1
g. Discipline	-.29	-	1
h. Content Development	-.23	-	1
i. Attitude Toward Curriculum	-.18	.20	2
j. Others	-.27	-	1

Teacher Characteristics Teacher Behavior	$\bar{r}$	S_r	n
23. Self-Sufficiency			12
a. Teacher Effectiveness	.01	-	1
b. Student-Teacher Interrelationship	.52	-	1
c. Teacher Orientation	-.54	-	1
d. Teacher-Student Orientation	-.12	.45	2
e. Student Orientation	.13	-	1
f. Low-Level, Tactual Questions	-.65	-	1
g. High, Complex Questions	.07	-	1
h. Discipline	.12	-	1
i. Achievement Tests	.06	-	1
j. Attitudes Toward Curriculum	-.08	.14	2
24. Adventurousness			2
a. Teacher-Student Orientation	.11	-	1
b. Achievement Tests	.04	-	1
25. Confidence			5
a. Teacher Effectiveness	.07	-	1
b. Teacher-Student Orientation	-.11	-	1
c. Achievement Tests	.14	-	1
d. Attitudes Toward Curriculum	.10	.02	2
26. Receptivity			12
a. Student-Teacher Interrelationship	.70	-	1
b. Teacher Orientations	-.48	-	1
c. Teacher-Student Orientation	-.50	-	1
d. Student Orientation	.27	.25	2
e. Low-Level, Tactual Questions	-.19	-	1
f. High, Complex Questions	.02	-	1
g. Discipline	.24	-	1
h. Attitudes Toward Curriculum	.22	.25	4
27. Objectivity			15
a. Student-Teacher Interrelationship	-.25	.37	2
b. Teacher Orientation	.13	.15	4
c. Teacher-Student Orientation	.46	.26	2
d. Verbal Behavior	-.24	-	1
e. Non-verbal Behavior	-.21	-	1
f. Congruent Statements	.62	-	1
g. Contradictory Statements	.07	-	1
h. Discipline	-.12	-	1
i. Use of Objectives	.21	-	1
j. Content Development	-.24	-	1
28. Adaptability			20
a. Teacher Effectiveness	.01	.02	3
b. Student-Teacher Interrelationship	.07	.45	2
c. Teacher Orientation	.66	.14	2
d. Teacher-Student Orientation	-.24	.02	3
e. Verbal Behavior	.40	-	1
f. Non-Verbal Behavior	-.60	-	1
g. Congruent Statements	.40	-	1
h. Contradictory Statements	-.36	-	1
i. Discipline	-.52	-	1
j. Use of Objectives	.07	-	1
k. Content Development	-.14	-	1
l. Achievement Tests	.14	-	1
m. Attitude Toward Curriculum	.10	.02	2

Teacher Characteristics Teacher Behavior	$\overline{r}$	S_r	n
29. Realism			12
a. Student & Teacher Interrelationship	.70	-	1
b. Teacher Orientation	.00	.24	3
c. Student-Teacher Orientation	-.36	-	1
d. Student Orientation	.23	-	1
e. Low-Level Tactual Questions	-.59	-	1
f. High, Complex Questions	-.22	-	1
g. Discipline	.49	-	1
h. Achievement Tests	.12	-	1
i. Attitude Toward Curriculum	.07	.03	2
30. Affiliation			13
a. Student & Teacher Interrelationship	-.10	.16	2
b. Teacher Orientation	.34	.24	2
c. Teacher-Student Orientation	.06	.20	2
d. Verbal Behavior	-.14	-	1
e. Non-verbal Behavior	-.05	-	1
f. Congruent Statements	.43	-	1
g. Contradictory Statements	.19	-	1
h. Discipline	-.05	-	1
i. Use of Objectives	.24	-	1
j. Content Development	-.26	-	1
31. Outgoingness			6
a. Teacher Effectiveness	.16	.13	2
b. Teacher Orientation	-.17	.04	2
c. Teacher-Student Orientation	.07	-	1
d. Achievement Tests	.02	-	1
32. Order			1
a. Teacher Effectiveness	.13	-	1
33. Endurance			1
a. Teacher Effectiveness	.92	-	1
34. Conscientousness			14
a. Teacher Effectiveness	.17	-	1
b. Teacher Orientation	-.18	-	1
c. Teacher-Student Orientation	-.15	.25	2
d. Student Orientation	.27	.22	2
e. Low-Level Tactual Questions	-.10	-	1
f. High, Complex Questions	.30	-	1
g. Discipline	.33	-	1
h. Achievement Tests	.12	-	1
i. Attitudes Toward Curriculum	-.03	.11	4
35. Intellectuality			5
a. Student Orientation	.05	-	1
b. Attitudes Toward Curriculum	.30	.12	4
36. Intelligence			2
a. Teacher-Student Orientation	.09	-	1
b. Achievement Tests	.25	-	1
37. Creativity			1
a. Teacher Effectiveness	.19	-	1

Teacher Characteristics Teacher Behavior	$\bar{r}$	S_r	n
38. Imagination			3
a. Teacher Effectiveness	.10	-	1
b. Teacher-Student Orientation	.09	-	1
c. Achievement Tests	.04	-	1
39. Motility			13
a. Student-Teacher Interrelationship	.08	.10	2
b. Teacher Orientation	.20	.01	2
c. Teacher Student Orientation	.10	.02	2
d. Verbal Behavior	-.05	-	1
e. Non-Verbal Behavior	.07	-	1
f. Congruent Statements	.29	-	1
g. Contradictory Statements	.57	-	1
h. Discipline	-.19	-	1
i. Use of Objectives	.52	-	1
j. Content Development	.02	-	1
40. Stability			15
a. Student-Teacher Interrelationship	-.12	.28	2
b. Teacher Orientation	-.25	.32	2
c. Teacher Student Orientation	.27	.03	3
d. Verbal Behavior	-.21	-	1
e. Non-verbal Behavior	.40	-	1
f. Congruent Statements	-.29	-	1
g. Contradictory Statements	-.17	-	1
h. Discipline	.40	-	1
i. Use of Objectives	-.64	-	1
j. Content Development	-.79	-	1
k. Achievement Tests	.25	-	1
41. Restraint			22
a. Student-Teacher Interrelationship	.26	.13	3
b. Teacher Orientation	-.54	.03	3
c. Teacher Student Orientation	-.04	.45	3
d. Student Orientation	.71	-	1
e. Verbal Behavior	-.02	-	1
f. Non-Verbal Behavior	.29	-	1
g. Congruent Statements	-.48	-	1
h. Contradictory Statements	-.05	-	1
i. Low-Level Tactual Questions	-.18	-	1
j. High Complex Questions	.14	-	1
k. Discipline	.34	.20	2
l. Use of Objectives	-.24	-	1
m. Content Development	.19	-	1
n. Attitudes Toward Curriculum	.08	.04	2
42. Anxiety			3
a. Teacher-Student Orientation	.09	-	1
b. Achievement Tests	.19	-	1
c. Others	-.03	-	1
43. Aggression			3
a. Teacher Effectiveness	.01	-	1
b. Teacher-Student Orientation	.16	-	1
c. Achievement Tests	.04	-	1
44. Leadership			14
a. Teacher Effectiveness	.74	-	1
b. Student-Teacher Interrelationship	-.28	.46	2
c. Teacher Orientation	.10	.16	2
d. Teacher-Student Orientation	.45	.17	2
e. Verbal Behavior	-.19	-	1

Teacher Characteristics Teacher Behavior	$\bar{r}$	S_r	n
f. Non-verbal Behavior	-.14	-	1
g. Congruent Statements	.43	-	1
h. Contradictory Statements	-.10	-	1
i. Discipline	-.17	-	1
j. Use of Objectives	.10	-	1
k. Content Development	-.07	-	1
45. Ego-Achievement			2
a. Attitudes Toward Curriculum	.08	.02	2
46. Forthrightness			1
a. Achievement Tests	.03	-	1
47. Conservation			3
a. Teacher Effectiveness	-.08	-	1
b. Teacher-Student Orientation	-.20	-	1
c. Achievement Tests	.13	-	1
48. Social Values			2
a. Teacher Effectiveness	.03	.07	2
49. Theoretical Values			2
a. Attitudes Toward Curriculum	-.16	.24	2
50. Attitude Toward Teaching			1
a. Achievement Tests	.27	-	1
51. Attitude Toward Science			9
a. Teacher Orientation	.20	.04	2
b. Student Orientation	.19	-	1
c. Questioning Behavior	.16	-	1
d. Flexible, Clarifying Questions	.19	-	1
e. High, Complex Questions	.28	-	1
f. Wait Time	.26	-	1
g. Method of Teaching	.11	-	1
h. Other	.24	-	1
52. Attitude Toward Science Teaching			6
a. Teacher Orientation	.32	.14	2
b. Teacher-Student Orientation	.06	-	1
c. Student Orientation	.80	-	1
d. Type of Curriculum	.46	-	1
e. Method of Teaching	.30	-	1
53. Moral and Ethical Self			2
a. Teacher Effectiveness	-.09	.04	2
54. Friendliness			13
a. Student-Teacher Interrelationship	.24	.05	2
b. Teacher Orientation	.42	.02	2
c. Teacher-Student Orientation	-.52	.16	2
d. Verbal Behavior	.57	-	1
e. Non-verbal Behavior	-.05	-	1
f. Congruent Statements	-.48	-	1
g. Contradictory Statements	-.50	-	1
h. Discipline	-.29	-	1
i. Use of Objectives	-.31	-	1
j. Content Development	.05	-	1

Teacher Characteristics Teacher Behavior	$\bar{r}$	S_r	n
55. Degree of Intellectual Orientation			2
a. Teacher Effectiveness	-.16	.05	2
56. Dogmatism			5
a. Teacher Orientation	-.08	.15	3
b. Achievement Tests	.80	-	1
c. Attitudes Toward Curriculum	-.32	-	1
57. Economic Values			4
a. Attitudes Toward Curriculum	-.20	.31	4
58. Cognitive Preference			7
a. Student & Teacher Interrelationship	.01	-	1
b. Teacher Orientation	.06	-	1
c. Student Orientation	-.15	-	1
d. Amount of Questioning	-.06	-	1
e. Discipline	-.11	-	1
f. Other	.00	.01	2
59. Masculinity			13
a. Student & Teacher Interrelationship	-.28	.14	2
b. Teacher Orientation	.00	.33	2
c. Teacher-Student Orientation	.22	.36	2
d. Verbal Behavior	-.38	-	1
e. Non-verbal Behavior	.19	-	1
f. Congruent Statements	.17	-	1
g. Contradictory Statements	-.12	-	1
h. Discipline	.43	-	1
i. Use of Objectives	-.26	-	1
j. Content Development	-.52	-	1
60. Use of Specific Curriculum			3
a. Teacher-Student Orientation	.07	-	1
b. Use of Objectives	.03	-	1
c. Use of Methods	.10	-	1

Table 10 Number of Correlations with Teacher Characteristics Reported for each Student Outcome Category.

Student Outcome	Number of Correlations
1. Student Cognitive Low	7
2. Student Cognitive High	5
3. Student Cognitive Mixture	73
4. Student Cognitive Preference	1
5. Student Critical Thinking	28
6. Student Aptial Reasoning	0
7. Student Logical Thinking	0
8. Student Creativity	0
9. Student Decision Making	0
10. Student Problem Solving	20
11. Student Curiosity	21
12. Student Response Behavior	0
13. Student Process Skills	91
14. Student Methods in Science	6
15. Student Self Concept	7
16. Student Affect Toward Science	51
17. Student Affect Toward Course	16
18. Student Affect Toward Method	4
19. Student Social Values	2
20. Student Technological Values	1
21. Student Theoretical Values	1
22. Student Psycho Motor	0
23. Other	14
Total	348

Table 11 Average Correlation for each Teacher Chracteristic by Student Outcome Combination

Teacher Characteristic Student Outcome	$\overline{r}$	S_r	n
1. Teacher Age			9
a. Student Cognitive Low	.50	-	1
b. Student Cognitive High	-.14	-	1
c. Student Cognitive Mixture	.11	.09	3
d. Student Critical Thinking	.12	-	1
e. Student Process Skills	.12	-	1
f. Student Methods in Science	.15	-	1
g. Student Affect Toward Science	.26	-	1
2. Number of Education Courses			6
a. Student Cognitive Low	-.62	-	1
b. Student Cognitive High	.47	-	1
c. Student Cognitive Mixture	-.01	.05	3
d. Student Affect Toward Science	-.01	-	1
3. Number of Science Courses			20
a. Student Cognitive Low	-.08	.06	2
b. Student Cognitive High	.25	-	1
c. Student Cognitive Mixture	.17	.25	7
d. Student Critical Thinking	.05	-	1
e. Student Process Skills	.18	.12	2
f. Student Methods in Science	.05	-	1
g. Student Affect Toward Science	.21	.12	5
h. Student Social Values	.06	-	1
4. Number of Biology Courses			8
a. Student Cognitive Mixture	.34	.27	4
b. Student Critical Thinking	.22	-	1
c. Student Process Skills	-.10	-	1
d. Student Methods in Science	.37	-	1
e. Student Affect Toward Science	.33	-	1
5. Number of Chemistry Courses			3
a. Student Cognitive Mixture	.67	-	1
b. Student Process Skills	.18	-	1
c. Other	.13	-	1
6. Number of Physics Courses			6
a. Student Cognitive Mixture	.42	-	1
b. Student Process Skills	.06	.12	2
c. Student Affect Toward Course	.09	.18	3
7. Experience Teaching Biology			7
a. Student Cognitive Mixture	.01	-	1
b. Student Critical Thinking	.08	-	1
c. Student Process Skills	.03	-	1
d. Student Affect Toward Science	.18	.06	4
8. Experience Teaching Physics			7
a. Student Cognitive Mixture	.27	-	1
b. Student Process Skills	.14	.02	2
c. Student Affect Toward Course	.14	.08	3
d. Other	.20	-	1

Teacher Characteristic Student Outcome	$\bar{r}$	S_r	n
9. Experience Teaching			16
a. Student Cognitive Low	.14	.20	2
b. Student Cognitive High	-.07	-	1
c. Student Cognitive Mixture	.24	.33	6
d. Student Critical Thinking	.22	-	1
e. Student Process Skills	-.00	.08	2
f. Student Methods in Science	.05	-	1
g. Student Affect Toward Science	.14	.16	2
h. Student Affect Toward Method	-.12	-	1
10. Educational Background			1
a. Student Cognitive Mixture	.12	-	1
11. Knowledge			16
a. Student Cognitive Low	-.39	-	1
b. Student Cognitive High	.49	-	1
c. Student Cognitive Mixture	.03	.14	4
d. Student Process Skills	-.09	.21	4
e. Student Affect Toward Course	-.10	.16	3
f. Student Affect Toward Method	-.13	-	1
g. Other	-.02	.08	2
12. Academic Institute			3
a. Student Cognitive Mixture	.16	.10	2
b. Student Process Skills	-.04	-	1
13. Exhibitionism			8
a. Student Cognitive Mixture	.00	-	1
b. Student Critical Thinking	.07	-	1
c. Student Problem Solving	.17	-	1
d. Student Curiosity	.00	-	1
e. Student Process Skills	-.06	.05	3
f. Student Self Concept	.04	-	1
14. Autonomy			3
a. Student Cognitive Mixture	.08	-	1
b. Student Process Skills	-.14	.08	2
15. Heterosexuality			9
a. Student Cognitive Mixture	.40	.02	2
b. Student Process Skills	.11	.30	4
c. Student Affect Toward Course	-.15	-	1
d. Other	-.12	.23	2
16. Enthusiasm			5
a. Student Critical Thinking	-.12	-	1
b. Student Problem Solving	-.16	-	1
c. Student Curiosity	-.05	-	1
d. Student Process Skills	-.14	-	1
e. Student Affect Toward Science	-.17	-	1
17. Self-Concept			3
a. Student Process Skills	-.20	.17	2
b. Student Affect Toward Method	-.19	-	1

Teacher Characteristic Student Outcome	$\overline{r}$	S_r	n
18. Self-Actualization			8
a. Student Cognitive Mixture	.46	.27	3
b. Student Critical Thinking	.13	-	1
c. Student Process Skills	-.05	-	1
d. Student Affect Toward Science	-.11	.17	2
e. Student Affect Toward Course	.33	-	1
19. Reflectivity			3
a. Student Process Skills	.02	-	1
b. Student Affect Toward Science	.05	-	1
c. Student Affect Toward Course	.15	-	1
20. Physical Self			1
a. Student Process Skills	-.01	-	1
21. Personal Self			1
a. Student Process Skills	-.00	-	1
22. Achievement			5
a. Student Cognitive Mixture	-.15	-	1
b. Student Process Skills	-.23	.11	2
c. Student Affect Toward Science	-.38	-	1
d. Other	-.30	-	1
23. Dominance			6
a. Student Cognitive Mixture	.00	-	1
b. Student Process Skills	-.04	.04	2
c. Student Affect Toward Science	-.44	-	1
d. Student Affect Toward Course	.27	-	1
e. Other	-.23	-	1
24. Self Sufficiency			1
a. Student Affect Toward Science	-.36	-	1
25. Confidence			5
a. Student Critical Thinking	-.12	-	1
b. Student Problem Solving	-.02	-	1
c. Student Curiosity	.05	-	1
d. Student Process Skills	-.07	-	1
e. Student Affect Toward Science	-.03	-	1
26. Receptivity			1
a. Student Affect Toward Science	-.44	-	1
27. Deference			4
a. Student Cognitive Mixture	.13	-	1
b. Student Process Skills	.04	.31	3
28. Change			3
a. Student Cognitive Mixture	-.19	-	1
b. Student Process Skills	-.14	.16	2
29. Realism			1
a. Student Affect Toward Science	-.56	-	1
30. Nurturance			3
a. Student Cognitive Mixture	-.14	-	1
b. Student Process Skills	.04	.14	2
31. Affiliation			8
a. Student Cognitive Mixture	-.08	-	1
b. Student Critical Thinking	-.02	-	1
c. Student Problem Solving	-.09	-	1
d. Student Curiosity	.18	-	1
e. Student Porcess Skills	-.05	.19	3
f. Student Affect Toward Science	.26	-	1

Teacher Characteristic Student Outcome		$\overline{r}$	S_r	n
32.	Outgoingness			5
	a. Student Critical Thinking	-.02	-	1
	b. Student Problem Solving	-.05	-	1
	c. Student Curiosity	.08	-	1
	d. Student Process Skills	-.10	-	1
	e. Student Affect Toward Science	-.06	-	1
33.	Order			3
	a. Student Cognitive Mixture	-.10	-	1
	b. Student Process Skills	.02	.16	2
34.	Endurance			8
	a. Student Cognitive Mixture	.12	-	1
	b. Student Critical Thinking	.07	-	1
	c. Student Problem Solving	-.13	-	1
	d. Student Curosity	.07	-	1
	e. Student Process Skills	.10	.14	3
	f. Student Affect Toward Science	.01	-	1
35.	Conscientiousness			1
	a. Student Affect Toward Science	-.52	-	1
36.	Planfulness			
	a. Student Critical Thinking	.01	-	1
	b. Student Problem Solving	-.14	-	1
	c. Student Curiosity	-.06	.08	2
	d. Student Process Skills	-.05	-	1
	e. Student Affect Toward Science	-.14	-	1
37.	Analytic Orientation			4
	a. Student Cognitive Mixture	.09	-	1
	b. Student Critical Thinking	.41	-	1
	c. Student Process Skills	.07	-	1
	d. Student Affect Toward Science	.19	-	1
38.	Restraint			1
	a. Student Affect Toward Science	-.35	-	1
39.	Anxiety			5
	a. Student Critical Thinking	-.05	-	1
	b. Student Problem Solving	-.01	-	1
	c. Student Curiosity	-.10	-	1
	d. Student Process Skills	.03	-	1
	e. Student Affect Toward Science	.06	-	1
40.	Aggression			4
	a. Student Cognitive Mixture	.13	-	1
	b. Student Process Skills	.04	.04	2
	c. Student Affect Toward Science	.38	-	1
41.	Abasement			4
	a. Student Cognitive Mixture	.02	-	1
	b. Student Process Skills	.20	.25	2
	c. Other	.41	-	1
42.	Leadership			5
	a. Student Critical Thinking	.09	-	1
	b. Student Problem Solving	.02	-	1
	c. Student Curiosity	.01	-	1
	d. Student Process Skills	-.19	-	1
	e. Student Affect Toward Science	-.07	-	1

	Teacher Characteristic Student Outcome	$\overline{r}$	S_r	n
43.	Conservatism			5
a.	Student Critical Thinking	.02	-	1
b.	Student Problem Solving	-.11	-	1
c.	Student Curiosity	.10	-	1
d.	Student Process Skills	.09	-	1
e.	Student Affect Toward Science	-.01	-	1
44.	Aesthetic Values			7
a.	Student Cognitive Mixture	.13	-	1
b.	Student Critical Thinking	-.01	-	1
c.	Student Problem Solving	.05	-	1
d.	Student Curiosity	-.12	-	1
e.	Student Process Skills	.00	.02	3
45.	Social Values			11
a.	Student Cognitive Mixture	.15	-	1
b.	Student Critical Thinking	.04	-	1
c.	Student Problem Solving	-.05	-	1
d.	Student Curiosity	.08	-	1
e.	Student Process Skills	-.06	.21	4
f.	Student Affect Toward Science	.05	-	1
g.	Student Social Values	.32	-	1
h.	Other	.33	-	1
46.	Theoretical Values			8
a.	Student Cognitive Mixture	-.24	-	1
b.	Student Critical Thinking	-.19	-	1
c.	Student Problem Solving	.02	-	1
d.	Student Curiosity	.03	-	1
e.	Student Process Skills	-.16	.34	3
f.	Student Theoretical Values	.32	-	1
47.	Technological Values			1
a.	Student Technological Values	.32	-	1
48.	Attitude Toward Science			13
a.	Student Cognitive Mixture	.10	.06	2
b.	Student Critical Thinking	.24	-	1
c.	Student Process Skills	-.29	-	1
d.	Student Methods in Science	.14	-	1
e.	Student Affect Toward Science	.10	.10	5
f.	Student Affect Toward Course	-.09	-	1
g.	Student Affect Toward Method	-.21	-	1
h.	Other	.06	-	1
49.	Attitude Toward Teaching Science			6
a.	Student Cognitive Mixture	.15	-	1
b.	Student Critical Thinking	.27	-	1
c.	Student Methods in Science	.11	-	1
d.	Student Affect Toward Science	.11	.06	2
e.	Other	.06	-	1
50.	Attitude Toward Specific Subject			2
a.	Student Affect Toward Science	.24	-	1
b.	Student Affect Toward Course	-.20	-	1
51.	Moral & Ethical Self			1
a.	Student Process Skills	.02	-	1
52.	Family Self			1
a.	Student Process Skills	-.06	-	1

Teacher Characteristic Student Outcome	$\bar{r}$	S_r	n
53. Social Self			6
a. Student Critical Thinking	-.05	-	1
b. Student Problem Solving	-.08	-	1
c. Student Curiosity	.03	-	1
d. Student Process Skills	.04	.04	2
e. Student Affect Toward Science	.09	-	1
54. Succorance			9
a. Student Cognitive Mixture	-.04	-	1
b. Student Critical Thinking	-.14	-	1
c. Student Problem Solving	-.08	-	1
d. Student Curiosity	-.09	-	1
e. Student Process Skills	.07	.25	4
f. Student Affect Toward Science	-.07	-	1
55. Degree of Intellectual Orientation			4
a. Student Critical Thinking	-.08	-	1
b. Student Problem Solving	-.01	-	1
c. Student Curiosity	-.02	-	1
d. Student Affect Toward Science	.06	-	1
56. Dogmatism			5
a. Student Critical Thinking	-.11	-	1
b. Student Problem Solving	-.15	-	1
c. Student Curiosity	-.09	-	1
d. Student Affect Toward Science	-.06	-	1
e. Other	.77	-	1
57. Religious Values			8
a. Student Cognitive Mixture	-.21	-	1
b. Student Critical Thinking	.15	-	1
c. Student Problem Solving	-.02	-	1
d. Student Curiosity	.09	-	1
e. Student Process Skills	.03	.09	3
f. Student Affect Toward Science	.10	-	1
58. Economic Values			7
a. Student Cognitive Mixture	.32	-	1
b. Student Problem Solving	-.07	-	1
c. Student Curiosity	-.04	-	1
d. Student Process Skills	.13	.08	3
e. Student Affect Toward Science	-.09	-	1
59. Political Values			9
a. Student Cognitive Mixture	-.03	-	1
b. Student Critical Thinking	-.02	-	1
c. Student Problem Solving	.06	-	1
d. Student Curiosity	.02	-	1
e. Student Process Skills	-.17	.08	3
f. Student Affect Toward Science	-.14	-	1
g. Other	-.29	-	1
60. Cognitive Preference			2
a. Student Cognitive Mixture	.40	-	1
b. Student Cognitive Preference	.14	-	1
61. Masculinity			2
a. Student Cognitive Mixture	.38	.22	2

Teacher Characteristic Student Outcome	$\overline{r}$	S_r	n
62. Use of Specific Curriculum			1
a. Student Cognitive Mixture	.07	-	1
63. Cognitive Pattern Similarity			2
a. Student Cognitive Mixture	.26	.04	2
64. Cognitive Level Similarity			1
a. Student Cognitive Mixture	.12	-	1

A META-ANALYSIS OF THE RELATIONSHIPS BETWEEN STUDENT CHARACTERISTICS AND STUDENT OUTCOMES IN SCIENCE

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INTRODUCTION

The purpose of this investigation was to summarize the results of research concerning the relationships between student characteristics and student performance related to science. These studies were summarized using a meta-analysis technique described by Glass et al. (1981). All codeable documents located for the years 1960 through 1981 and conducted within kindergarten through twelfth grade were included in this analysis. Tables 1 through 3 include frequencies of cases coded by year of publication, sample sizes and age and grade levels.

The major source of the literature reviewed came from dissertations on loan from the ERIC Center for Science and Mathematics located at Ohio State University. Additional research studies were located by reviewing research summaries, bibliographies of codeable studies, and computerized searches of available research. An article-by-article search was also conducted with the Journal of Reserach in Science Teaching (JRST), beginning in the early 1960's, and with Science Education, beginning in 1968. Other journals examined included: Child Development, Educational and Psychological Measurement, Educational Leadership, Journal of Educational Research, National Association of Secondary School Principals' Bulletin, Psychological Bulletin, School Science and Mathematics, and School Science Review,

The majority of studies included in this investigation were coded from dissertations. A total of 227 dissertations were reviewed. Fifty-four percent of these (122 dissertations) were codeable. Studies were deemed codeable if they dealt with student characteristics selected and included sufficient or relevant data to initiate meta-analysis transformations. Tables 4 and 5 specify statistics sources. When research was reported as dissertations and subsequently as journal articles or fugitive documents, only dissertations were coded. This was the procedure of choice as dissertations contain more raw data pertinent to meta-analysis transformations. Forty-one journal articles, five fugitive documents, and results of the 1978 National Assessment of Educational Progress (NAEP)were also coded. Codeable studies consisted of 73% dissertations, 24% journal articles and NAEP data, and 3% fugitive documents.

The researchers attempted to code all studies in which characteristics of students were compared with cognitive and affective outcomes in science. The science content reflected in the studies coded appear in Table 6. Method of measurement is reported in Table 7.

CASE FREQUENCIES

TABLE 1: Dates of Cases Coded

DATE	FREQUENCIES
1960	1
1961	2
1962	8
1963	9
1964	7
1965	19
1966	19
1967	20
1968	14
1969	11
1970	23
1971	30
1972	23
1973	28
1974	14
1975	6
1976	5
1977	10
1978	44 (NAEP study year)
1979	6
1980	2
1981	1
TOTAL:	302
MISSING:	6

TABLE 2: Sample Size

NUMBER OF SUBJECTS IN SAMPLE	CASE FREQUENCY
less than 50	5
50-100	43
100-500	158
500-1000	23
1000-10,000	40
10,000-100,000	36
TOTAL:	305
MISSING:	3

TABLE 3: Mean Age and Grade Level

MEAN AGE	CASE FREQUENCY	GRADE LEVEL	CASE FREQUENCY
6	3	0	1
7	4	1	5
8	9	2	2
9	34*	3	6
10	25	4	37
11	21	5	29
12	17	6	19
13	27*	7	12
14	31	8	26
15	37	9	28
16	59	10	40
17	33*	11	52
18	3	12	37
TOTAL:	304	TOTAL:	294
MISSING:	4	MISSING:	14

*NAEP age

TABLE 4: Sources of Correlation Statistics

SOURCE	CASE FREQUENCY
raw data	13
transformations from other statistics	197
direct from correlations reported	91
TOTAL:	301
MISSING:	7

TABLE 5: Sources of Delta Statistics

SOURCE	CASE FREQUENCY
raw data	11
transformations from correlations	101
transformations from other statistics	5
TOTAL:	116
MISSING:	192

TABLE 6: Case Science Content

CONTENT	CASE FREQUENCY
elementary science	80
general science	49
biology	35
earth science	7
physical science	13
chemistry	29
physics	13
other science	7
combination of preceding	57
non-science	15
TOTAL:	305
MISSING:	3

TABLE 7: Methods of Measurement

MEASUREMENT	CASE FREQUENCY
published: national, standardized	141
ad hoc written tests	105
classroom evaluation (other than published or ad hoc)	17
interview	14
TOTAL:	277
MISSING:	31

COGNITIVE LEVEL, SCIENCE ACHIEVEMENT AND SCIENCE ATTITUDES RESULTS

The relationships of the following measures of student performance with student characteristics are described within this narrative.

Combined cognitive level performance is defined as outcomes of any test instruments or observational procedures that measure students' ability to perform on tasks written at various taxonomic levels (Bloom et al., 1974) or at various Piagetean levels (Inhelder and Piaget, 1958; Piaget, 1964a and 1964b). It should be noted that Piagetean research accounted for few (0-10%) of the total number of studies in this performance category. Also included in this category are students' critical thinking ability and decision making, process and problem solving skills.

Science achievement is the result of any test instrument that measures science achievement in content areas taught in kindergarten through twelfth grade or by grades achieved by students in science classes.

Science attitudes are the findings of any measures of student attitudes toward science, a science content area, science instruction, science curriculum, or scientists.

All student characteristics' relationships with these three measures of student performance are reported in either Tables 8, 13, or 18. Reported first are combined findings in the areas of students general ability, language ability and mathematical ability and studies in which socioeconomic status, gender and race are compared with student science outcomes. Other student characteristics, correlated with these three measures follow. Further breakdowns by grade level and science subject area may be found in Tables 9 through 12, 14 through 17 and 19.

STUDENT ABILITIES AND SOCIO-ECONOMIC STATUS

As the results of investigated relationships of the personological variables general ability, language ability, and mathematical ability with performance measures are quite similar, they will be discussed simultaneously. The personological variable general ability consisted of a number of measures of general, verbal, or mathematical intelligence (IQ); verbal and mathematical Scholastic Aptitude Tests (SAT); language ability or achievement; and mathematical ability or achievement. Combined in language ability are the measures of verbal IQ, verbal SAT, and other language ability or achievement. Mathematical IQ, mathematical SAT, and other arithmetic and mathematics ability or achievement comprised the mathematical ability category.

The results of Table 8 indicate that for all studies included in this investigation of general ability, language ability, and mathematical ability correlate almost equally with combined cognitive level measures. Correlations range from .47 with general ability to .53 with language ability. The breakdowns in Tables 9, 10, and 11 show the results to be consistent regardless of grade level or subject area. For each category of ability the strongest relationships (.60 to .70) are found in subjects participating in general science courses.

Cognitive levels as defined by Bloom and Piaget are broken out of the combined cognitive level and reported separately in Table 8. Correlations for general ability and language ability with Piagetean cognitive level are only 79 and 54 percent as large, respectively, as those found for the ability measures with Bloom's cognitive level. Although many studies investigating students' Piagetean level were located, only a small number of these were codeable by meta-analysis techniques. Many of these Piagetean studies included only data

TABLE 8

CORRELATIONS OF STUDENT ABILITIES AND SOCIO-ECONOMIC STATUS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

	COMBINED COGNITIVE LEVEL	COGNITIVE LEVEL (BLOOM)	COGNITIVE LEVEL (PIAGET)	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
GENERAL ABILITY	r* = .47 s* = .20 N* = 112	r = .48 s = .19 N = 101	r = .38 s = .24 N = 11	r = .43 s = .22 N = 42	r = .15 s = .16 N = 13
LANGUAGE ABILITY	r = .53 s = .11 N = 24	r = .56 s = .01 N = 21	r = .30 s = .31 N = 3	r = .41 s = .16 N = 5	INSUFFICIENT STUDIES
MATHEMATICS ABILITY	r = .51 s = .19 N = 19	INSUFFICIENT STUDIES		r = .42 s = .19 N = 13	
SES (HIGH-LOW)	r = .29 s = .14 N = 47			r = .25 s = .09 N = 21	r = .03 s = .11 N = 13

*AN "r" ON THIS TABLE REPRESENTS THE AVERAGE CORRELATION OF VARIABLES LISTED WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES. A POSITIVE CORRELATION FAVORS HIGHER ABILITY OR SES.

AN "s" REPRESENTS THE STANDARD DEVIATION AMONG THE STUDIES LOCATED FOR A PARTICULAR RELATIONSHIP.

AN "N" INDICATES THE NUMBER OF STUDIES LOCATED FOR A PARTICULAR RELATIONSHIP.

TABLE 9

BREAKDOWNS OF RELATIONSHIPS OF GENERAL ABILITY WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

GENERAL ABILITY (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
ELEMENTARY SCHOOL (K-6)	r* = .46 s* = .18 N* = 50	r = .25 s = .20 N = 9	r = .14 s = .12 N = 5
MIDDLE SCHOOL (7-9)	r = .49 s = .31 N = 19	r = .59 s = .12 N = 5	r = .12 s = .13 N = 5
HIGH SCHOOL (10-12)	r = .46 s = .20 N = 32	r = .47 s = .36 N = 14	r = .21 s = .08 N = 3
ELEMENTARY SCIENCE	r = .41 s = .22 N = 36	INSUFFICIENT STUDIES	r = .12 s = .15 N = 5
GENERAL SCIENCE	r = .60 s = .22 N = 15	INSUFFICIENT STUDIES	r = .24 s = .17 N = 3
LIFE SCIENCE	r = .47 s = .22 N = 18	INSUFFICIENT STUDIES	r = .22 s = .04 N = 4
PHYSICAL SCIENCE	r = .49 s = .20 N = 27	INSUFFICIENT STUDIES	INSUFFICIENT STUDIES

*SEE TABLE 8

TABLE 10

BREAKDOWN OF RELATIONSHIPS OF LANGUAGE ABILITY WITH MEASURES OF COGNITIVE LEVEL BY GRADE LEVEL AND SUBJECT AREAS

LANGUAGE ABILITY (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL
ELEMENTARY SCHOOL (K-6)	r* = .55 s* = .19 N* = 13
MIDDLE SCHOOL (7-9)	r = .59 s = .16 N = 3
HIGH SCHOOL (10-12)	r = .47 s = .11 N = 8
ELEMENTARY SCIENCE	r = .53 s = .49 N = 5
GENERAL SCIENCE	r = .70 s = .05 N = 3
LIFE SCIENCE	r = .39 s = .12 N = 2
PHYSICAL SCIENCE	r = .55 s = .11 N = 8

*SEE TABLE 8

TABLE 11

BREAKDOWN OF RELATIONSHIPS OF MATHEMATICS ABILITY WITH MEASURES OF COGNITIVE LEVEL BY GRADE LEVELS AND SUBJECT AREAS

MATHEMATICS ABILITY (BY GRADE AND SUBJECT)	COMBINED COGNITIVE LEVEL
ELEMENTARY SCHOOL (K-6)	r* = .47 s* = .09 N* = 10
MIDDLE SCHOOL (7-9)	INSUFFICIENT STUDIES
HIGH SCHOOL (10-12)	r = .39 s = .11 N = 5
GENERAL SCIENCE	r = .63 s = .29 N = 3
PHYSICAL SCIENCE	r = .48 s = .22 N = 8

*SEE TABLE 8

on the proportion of students operating at various developmental levels and no further statistical analysis.

Table 8 shows that relationships between the selected ability measures (general ability, language ability, and mathematics ability) and students' science achievements are similar to those found with combined cognitive level measures. The correlations range from .41 to .43 and are slightly lower than those found with the cognitive measures. There is considerable variability when the relationships are viewed by grade level, as illustrated in Table 11. The relationship between general ability and science achievement is lowest at the elementary school level (r = .25). This correlation coefficient more than doubles at the middle school level (r = .59) and decreases again by about 20% during the high school years (r = .47).

No further breakdowns of these data were possible as too few studies were found that looked at general ability with specific science subject areas or at language and mathematical ability. When few studies are available in viewing a particular relationship or breakdown, results tend to be erratic, and interpretation would be misleading. Where fewer than three studies were found, no results were reported.

The relationship between general ability and science attitudes is also shown in Table 8. The correlation between one's general ability and science attitude (r = .15) is roughly one-third as large as those found between ability and cognitive measures or science achievement. This finding is consistent across grade levels (see Table 11), although the relationship shows an increase from middle school (r = .12) to high school studies (r = .21). Breakdowns by elementary science (r = .12), general science (r = .24), and life science (r = .22) reinforce this apparent trend reflected in the grade level breakdown.

TABLE 12

BREAKDOWN OF RELATIONSHIPS OF SOCIO-ECONOMIC STATUS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

SES (BY GRADE LEVEL & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
ELEMENTARY SCHOOL (K-6)	r* = .30	r = .20	r = .09
	s* = .20	s = .12	s = .07
	N* = 19	N = 9	N = 3
MIDDLE SCHOOL (7-9)	r = .29	r = .26	r = .02
	s = .09	s = .06	s = .12
	N = 12	N = 5	N = 5
HIGH SCHOOL (10-12)	r = .28	r = .30	r = -.002
	s = .07	s = .05	s = .12
	N = 14	N = 6	N = 5
ELEMENTARY SCIENCE	r = .24	INSUFFICIENT STUDIES	
	s = .12		
	N = 9		
GENERAL SCIENCE	r = .32		
	s = .30		
	N = 4		
LIFE SCIENCE	r = .29		
	s = .04		
	N = 4		
PHYSICAL SCIENCE	r = .23		
	s = .14		
	N = 4		

*SEE TABLE 8

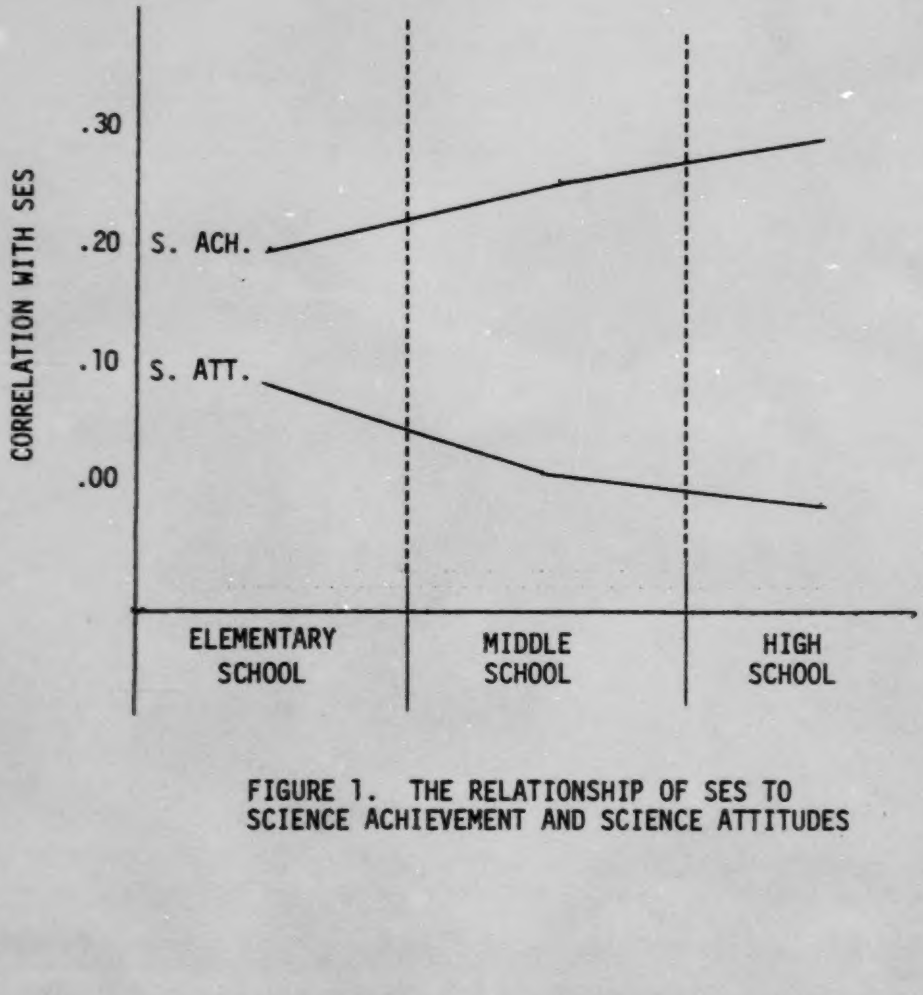

FIGURE 1. THE RELATIONSHIP OF SES TO SCIENCE ACHIEVEMENT AND SCIENCE ATTITUDES

The variable socio-economic status (SES) included in most studies is based either on father's income, average income of a school district, average income of the area where students live, or measures considering several of these factors. A positive correlation indicates that upper SES students scored higher than lower SES students on performance measures.

In Table 8 the relationship of SES with the combined cognitive measures, science achievement, and science attitudes is summarized. The correlations of SES with cognitive measures and science achievement are .25 and .29, respectively. These are approximately 40 percent smaller than correlations reported for the relationship of general ability for the same performance measures. The SES relationship with cognitive measures is constant across grade level and subject area (Table 12). However, the relationship between SES and science achievement increases with grade level. This trend is similar to that noted from Table 9 for general ability.

The correlation between SES and science attitudes (Table 8) is inconsequential (r = .03) when compared with those between SES and cognitive measures and between SES and science achievement. The breakdown of these relationships shown in Table 12 indicates that the low correlation between SES and science attitudes decreases from .09 in elementary school to -.002 in high school. Correlations of SES to science achievement and science attitudes appear to have an inverse relationship as grade level increases (see Figure 1).

GENDER AND RACE

The results of all effect size analyses considered by this investigation for these selected measures of student performance are summarized in Table 13. Effect sizes (Δ) are the mean differences between groups divided by a measure of pooled standard deviations for the groups.

$$\Delta_p = \frac{\bar{x}_1 - \bar{x}_2}{Sd_p}$$

In every case a positive effect size (Δ) favors the first group listed in the comparison. In order to compare the influence of gender and race with those of other student characteristics, it is useful to consider effect sizes in terms of zero-order correlations. Correlations are reported in parentheses on Tables 13 through 17.

Table 13 shows that males tend to score somewhat higher than females on combined cognitive measures ($\Delta = .13$), science achievement measures ($\Delta = .16$), and science attitude measures ($\Delta = .08$). The effect sizes reported for gender by science attitudes are only half as large as those reported for gender by science achievement. When these findings are broken down by grade level and subject area (Table 14), several trends become apparent.

At the elementary school level, differences in effect sizes on the combined cognitive measures ($\Delta = .06$) and science achievement measures ($\Delta = .04$) are only about 20 percent as large as at the middle school level. At the middle school level, males outperform females on both cognitive measures ($\Delta = .23$) and science achievement measures ($\Delta = .32$). This difference decreases by about 50 percent when student reach the high school level. At the high school level males also score higher than females on cognitive measures ($\Delta = .12$) and on science achievement measures ($\Delta = .15$). No breakdowns were possible with Piagetean cognitive level due to the limited number of codeable studies.

An entirely different relationship exists between gender and science attitude. In elementary school males have more positive attitudes toward science ($\Delta = .18$) than females. At the middle school level the reverse is true, with females having more positive attitudes toward science ($\Delta = -.11$).

TABLE 13

RELATIONSHIPS OF GENDER AND RACE WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

	COMBINED COGNITIVE LEVEL	COGNITIVE LEVEL (PIAGET)	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
GENDER MALE/FEMALE	Δ*=.13 (r**=.07) s*=.26 (s**=.14) N*=96 (N**=112)	INSUFFICIENT (r=.13) STUDIES (s=.23) (N=4)	Δ=.16 (r=.09) s=.32 (s=.15) N=45 (N=49)	Δ=.08 (r=.07) s=.25 (s=.16) N=31 (N=37)
RACE ANGLO/BLACK	Δ=.42 (r=.17) s=.16 (s=.06) N=34 (N=35)	INSUFFICIENT STUDIES	Δ=.41 (r=.16) s=.17 (s=.07) N=15 (N=15)	Δ=10 (r=.002) s=.04 (s=.05) N=11 (N=11)
RACE ANGLO/HISPANIC	Δ=.32 (r=.10) s=.12 (s=.08) N=32 (N=32)		Δ=.28 (r=.09) s=.14 (s=.08) N=14 (N=.14)	Δ=.05 (r=.02) s=.09 (s=.02) N=11 (N=11)
RACE BLACK/HISPANIC	Δ=-.04 (r=-.03) s=.13 (s=.07) N=30 (N=30)		Δ=-.02 (r=-.01) s=.14 (s=.08) N=12 (N-12)	Δ=.04 (r=.02) s=.12 (s=.05) N=11 (N=11)

*A " Δ " ON THIS TABLE REPRESENTS THE EFFECT SIZE RELATIONSHIP OF PERSONOLOGICAL VARIABLES LISTED WITH MEASURES OF COGNITIVE LEVEL, ACHIEVEMENT, AND ATTITUDES. A POSITIVE EFFECT SIZE FAVORS THE FIRST GROUP LISTED UNDER THE VARIABLE CATEGORY,

$$\Delta_P = \frac{\bar{X}_1 - \bar{X}_2}{sd_{POOLED}}$$

AN"s" REPRESENTS THE STANDARD DEVIATION AMONG THE STUDIES LOCATED FOR A PARTICULAR RELATIONSHIP.

AN "N" INDICATES THE NUMBER OF STUDIES LOCATED FOR A PARTICULAR RELATIONSHIP.

**SEE TABLE 8

TABLE 14

BREAKDOWN OF RELATIONSHIPS OF GENDER WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

(BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
ELEMENTARY SCHOOL (K-6)	Δ*=.06 (r**=.05) s*=.17 (s**=.11) N*=36 (N**=41)	Δ=.04 (r=.04) s=.15 (s=.09) N=16 (N=9)	Δ=.18 (r=.10) s=.25 (s=.16) N=9 (N=11)
MIDDLE SCHOOL (7-9)	Δ=.23 (r=.08) s=.35 (s=.18) N=22 (N=25)	Δ=.32 (r=.14) s=.47 (s=.22) N=11 (N=11)	Δ=-.11 (r=-.01) s=.37 (s=.18) N=7 (N=7)
HIGH SCHOOL (10-12)	Δ=.12 (r=.07) s=.24 (s=.13) N=37 (N=45)	Δ=.15 (r=.10) s=.27 (s=.15) N=17 (N=18)	Δ=.12 (r=.07) s=.13 (s=.14) N=15 (N=19)
ELEMENTARY SCIENCE	Δ=.09 (r=.05) s=.23 (s=.15) N=22 (N=25)	INSUFFICIENT STUDIES	Δ=-.08 (r=-.03) s=.56 (s=.26) N=5 (N=6)
GENERAL SCIENCE	Δ=.29 (r=.10) s=.45 (s=.20) N=10 (N=14)		Δ=.37 (r=.14) s=.06 (s=.09) N=3 (N=4)
LIFE SCIENCE	Δ=.02 (r=.01) s=.15 (s=.08) N=13 (N=14)	INSUFFICIENT STUDIES	
PHYSICAL SCIENCE	Δ=.30 (r=.15) s=.29 (s=.15) N=11 (N=11)		Δ=-.09 (r=-.02) s=.15 (s=.07) N=3 (N=3)
CHEMISTRY	Δ=.16 (r=.09) s=.28 (s=.15) N=8 (N-13)		Δ=.02 (r=-.05) s-.19 (s=.13) N=3 (N=4)

*SEE TABLE 13
**SEE TABLE 8

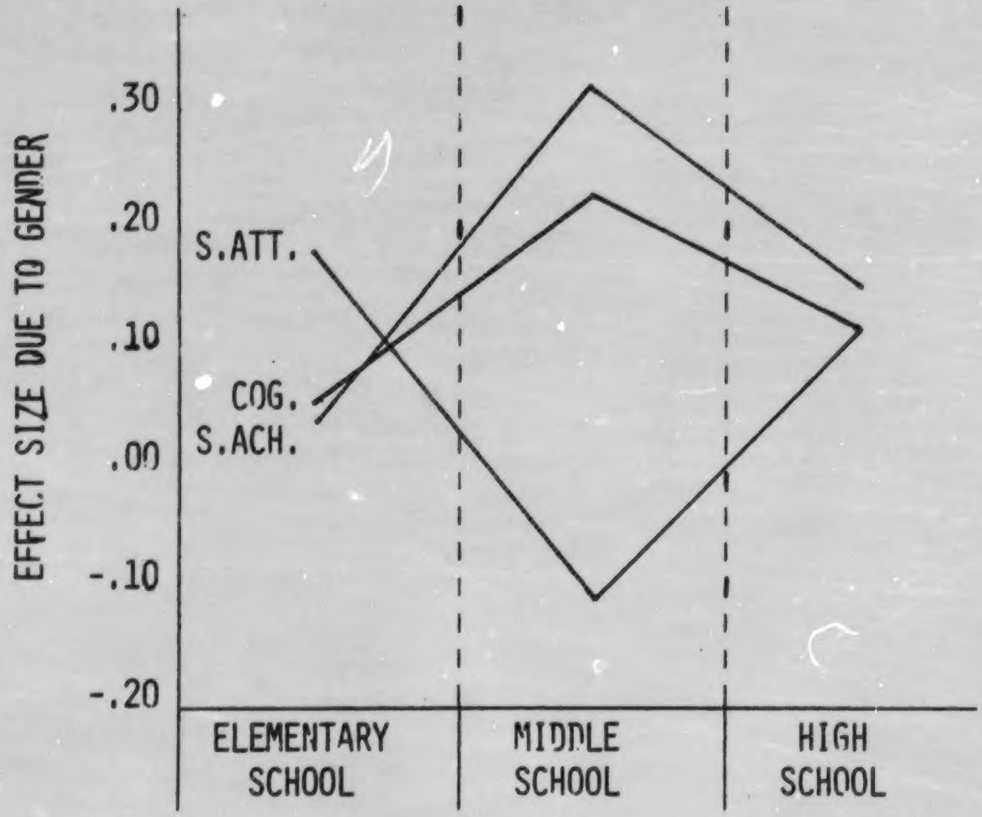

FIGURE 2. THE RELATIONSHIP OF GENDER TO COGNITIVE MEASURES, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

This trend reverses again among high school students, where males again outscore females on science attitude measures (Δ = .12). This inverse relationship for gender by cognitive and science achievement measures, and science attitude measures is depicted in Figure 2.

Breakdowns by subject areas (Table 14) also show interesting results for the relationship of gender to the three performance measures. The characteristic, gender, in elementary science (Δ = .09) reinforces the relationship found for cognitive measures at the elementary level. The effects of gender in elementary science on science attitudes tends to conflict with the those for gender with science attitudes at the elementary grade level. It should be noted, however that the standard deviation among these studies (sd = .56) in elementary science is quite large and based on only five studies. Further study is recommended in the area of male/female attitudes toward science at the elementary school level.

Studies of physical science, general science and chemistry show that males score higher than females, Δ = .30, Δ = .29, and Δ = .16, respectively, on cognitive measures. These conclusions are not apparent for the students in life science classes. The effect size of .02 shows negligible differences on cognitive measures. Males' attitudes toward science are more positive than females' attitudes in general science (Δ = .37) and chemistry classes (Δ = .02). But females' attitudes were more positive in physical science classes (Δ = -.09). No further breakdowns were possible, due to insufficient numbers of studies, for science achievement and science attitudes.

Effect sizes for comparisons of race groups (Anglo/Black, Anglo/Hispanic and Black/Hispanic) on the three performance measures are shown on Table 13. The summarized studies indicate that Anglos score higher than Blacks on cognitive measures (Δ = .42), science achievement measures (Δ = .41), and science attitude measures (Δ =.10). The effect size reported for race (Anglo/Black) by science achievement and by cognitive measures. These findings are broken down by grade level and subject area on Table 15.

Grade level analyses for race (Anglo/Black) by the three performance measures are illustrated in Figure 3. Effect sizes for cognitive measures and science achievement remain fairly constant across grade levels. A slight variation from this trend is shown at the elementary school level for science achievement where the effect is approximately 20 percent smaller than at the higher grade levels. Science attitudes at the elementary school level are more favorable for Anglo subjects than for Black subjects. These differences in attitudes seem to dissipate by the middle school level and begin to show more favorable attitudes for Blacks at the high school level.

Physical science and life science breakdowns show nearly identical effect sizes (Δ = .37 and Δ = .34, respectively), indicating higher performance on cognitive measures by Anglos than for Blacks. No other breakdowns were possible due to insufficient numbers of studies.

Effect sizes for Anglo/Hispanic race group comparisons on the three performance measures indicate that Anglos score higher than Hispanics on cognitive measures (Δ = .32), science achievement measures (Δ = .28), and science attitude measures (Δ = .05). (See Table 13).

The effect size differences between races are consistently smaller when comparing Anglos and Hispanics than when comparing Anglos and Blacks. It is approximately 75 percent as large for cognitive measures, 65 percent as large for science achievement measures, and 50 percent as large for science attitude measures. As was seen with Anglo/Black comparisons, the effect size reported for science attitudes (Δ = .05) is only 15 to 20 percent as large as those reported for cognitive and science achievement measures. These findings are broken down by grade level and subject areas on Table 16.

TABLE 15

BREAKDOWN OF ANGLO/BLACK RELATIONSHIPS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

RACE-ANGLO/BLACK (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL		SCIENCE ACHIEVEMENT		SCIENCE ATTITUDES	
ELEMENTARY SCHOOL (K-6)	Δ*=.43 s*=.17 N*=11	(r**=.17) (s**=.06) (N**=13)	Δ=.34 s=.07 N=5	(r=.14) (s=.04) (N=6)	Δ=.40 s=.69 N=3	(r=.03) (s=.05) (N=3)
MIDDLE SCHOOL (7-9)	Δ =.42 s =.18 N=12	(r = .19) (s = .07) (N=12)	Δ=.46 s=.28 N=5	(r=.20) (s=.12) (N=5)	Δ=.02 s=.11 N=4	(r=.01) (s=.05) (N=4)
HIGH SCHOOL (10-12)	Δ =.42 s =.13 N = 11	(r = .15) (s = .05) (N = 10)	Δ=.42 s=.11 N=5	(r=.15) (s=.04) (N=4)	Δ=-.06 s=.17 N=4	(r=-.02) (s=.07) (N=4)
ELEMENTARY SCIENCE	INSUFFICIENT STUDIES	(r = .13) (s = .06) (N = 3)	INSUFFICIENT STUDIES			
LIFE SCIENCE	Δ = .34 s = .12 N = 4	(r = .12) (s = .04) (N = 3)				
PHYSICAL SCIENCE	Δ = .37 s = .05 N = 3	(r = .15) (s = .01) (N = 3)				

*SEE TABLE 13

**SEE TABLE 8

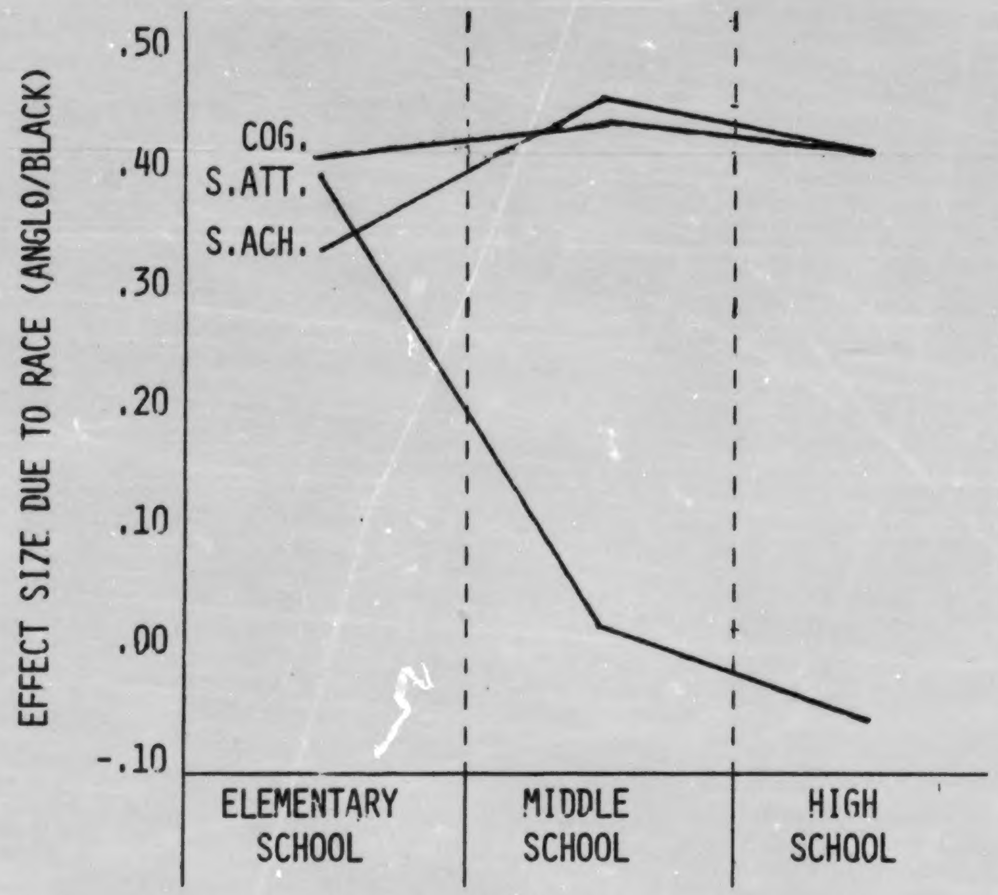

FIGURE 3. THE RELATIONSHIP OF RACE (ANGLO/BLACK) TO COGNITIVE MEASURES, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

TABLE 16

BREAKDOWN OF RACE: ANGLO/HISPANIC RELATIONSHIPS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

RACE-ANGLO/HISPANIC (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL		SCIENCE ACHIEVEMENT		SCIENCE ATTITUDES	
ELEMENTARY SCHOOL (K-6)	Δ*=.35	(r**=.13)	Δ=.33	(r=.13)	Δ=.08	(r=.02)
	s*=.16	(s**=.12)	s=.19	(s=.22)	s=.16	(s=.04)
	N*=12	(N**=12)	N=6	(N=6)	N=3	(N=3)
MIDDLE SCHOOL (7-9)	Δ =.33	(r = .09)	Δ=.30	(r=.10)	Δ=.02	(r=.01)
	s =.05	(s = .04)	s=.06	(s=.06)	s=.06	(s=.01)
	N=10	(N=10)	N=4	(N-4)	N=4	(N=4)
HIGH SCHOOL (10-12)	Δ=.28	(r = .06)	Δ=.20	(r=.04)	Δ=.07	(r=.02)
	s=.12	(s = .03)	s=.08	(s=.02)	s=.05	(s=.02)
	N=10	(N=10)	N=4	(N=4)	N=4	(N-4)
LIFE SCIENCE	Δ=.20	(r=.09)	INSUFFICIENT STUDIES			
	s=.08	(s=.09)				
	N=3	(N=3)				
PHYSICAL SCIENCE	Δ=.28	(r=.06)				
	s=.04	(s=.01)				
	N=3	(N=3)				

*SEE TABLE 13

**SEE TABLE 8

Grade level breakdowns for race (Anglo/Hispanic) by the three performance measures are further illustrated in Figure 4. This figure indicates that race (Anglo/Hispanic) differences on cognitive measures and science achievement measures exhibit a slow but steady decline from elementary school to high school. The small race (Anglo/Hispanic) differences on science attitude measures remain constant from elementary school to high school and are smallest at the middle school level.

Anglos score higher than Hispanics on life science and physical science measures (Δ = .20 and .28, respectively). Due to insufficient numbers of studies available, no further breakdowns were possible.

Studies which compared the scores of Blacks and Hispanics show almost no differences between the groups. On cognitive measures and in science achievement Hispanics score slightly better (Δ = -.04 and Δ = -.02, respectively). Science attitudes were slightly better for Blacks (Δ = .04).

Breakdowns by Grade Level and Subject Areas for Blacks and Hispanics are in Table 17. Effect size differences are much smaller for this race comparison than those comparing Anglos with each of these groups. Across all grade strata, differences remain constant on cognitive and science achievement measures. The smallest differences occur at middle school age on the cognitive and attitude scores and for elementary age students in science achievement. More favorable attitudes of Blacks are evident at the high school level. (See Figure 5.)

The differences in science subject areas is also slight. Hispanics scored better in life science (Δ = -.01); Blacks better in physical science (Δ =.06).

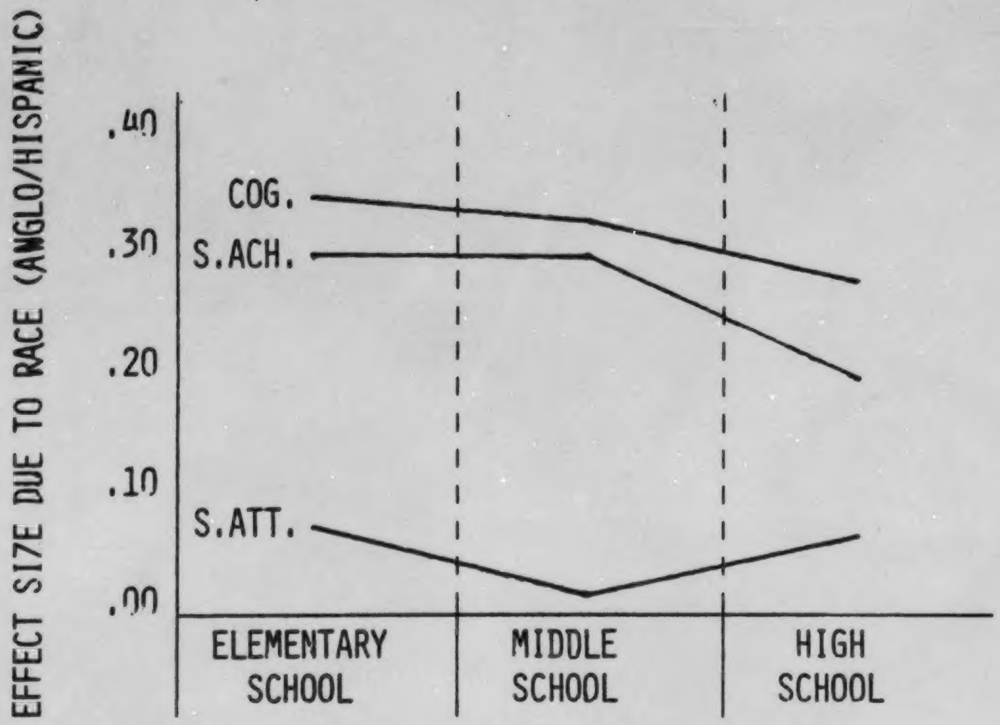

FIGURE 4. THE RELATIONSHIP OF RACE (ANGLO/HISPANIC) TO COGNITIVE MEASURES, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

TABLE 17

BREAKDOWN OF RACE: BLACK/HISPANIC RELATIONSHIPS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS & SUBJECT LEVELS

Race Black/Hispanic (By Grade & Subject)	Combined Cognitive Level	Science Achievement	Science Attitudes
Elementary School (K-6)	Δ*=-.07 (r**=-.04) s*= .15 (s**= .09) N*= 10 (N**= .10)	Δ=-.01 (r=-.02) s= .20 (s= .12) N=4 (N=4)	Δ=.01 (r=.003) s=.08 (s=.04) N=3 (N=3)
Middle School (7-9)	Δ=-.004 (r=-.01) s= .09 (s= .05) N=10 (N=10)	Δ=-.04 (r=-.02) s= .01 (r= .01) N=4 (N=4)	Δ=-.002 (r=.01) s= .09 (s=.06) N=4 (N=4)
High School (10-12)	Δ=-.06 (r=-.02) s= .14 (s= .06) N=10 (N=10)	Δ=-.02 (r=-.01) s= .17 (s= .09) N=4 (N=4)	Δ=.11 (r=.05) s=.16 (s=.06) N=4 (N=4)
Life Science	Δ=-.01 (r=-.01) s= .13 (s= .07) N=3 (N=3)	INSUFFICIENT STUDIES	
Physical Science	Δ=.06 (r=.03) s=.09 (s=.04) N=3 (N=3)		

*See Table 13
**See Table 8

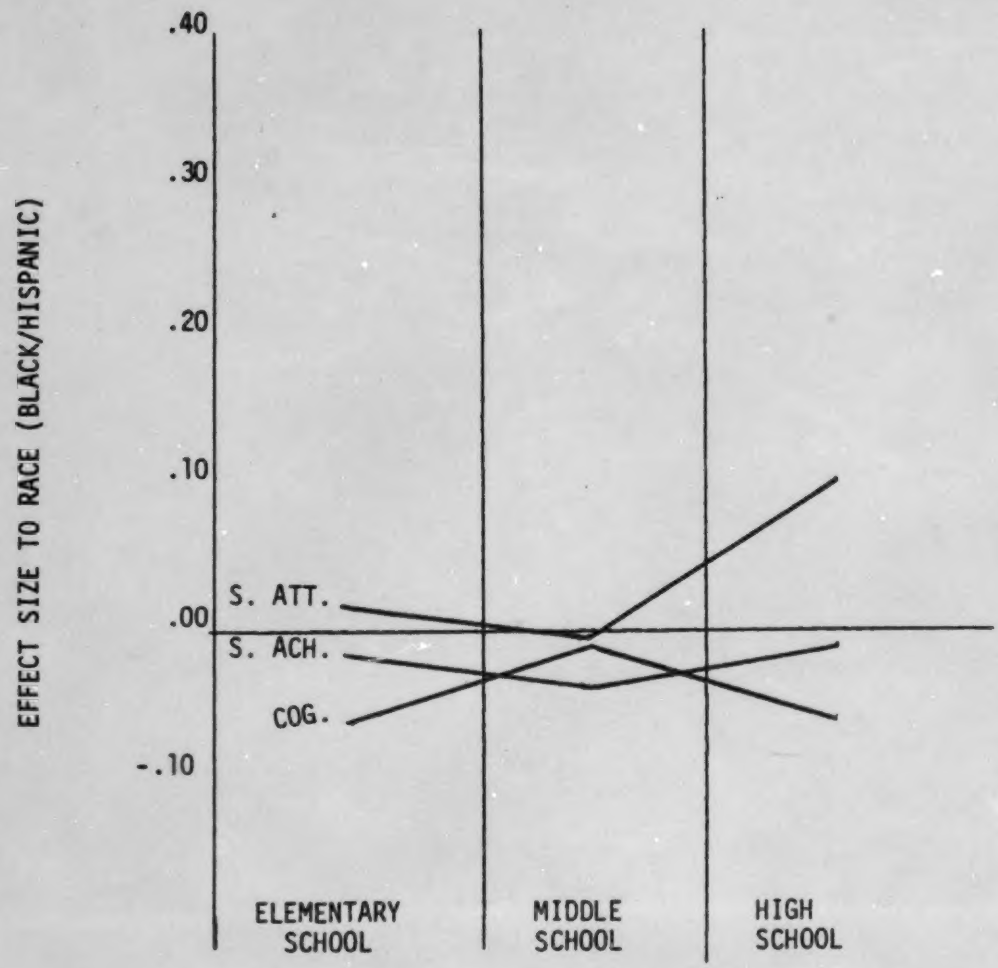

Figure 5. The Relationship of Race (Black/Hispanic) to Cognitive Measures, Science Achievement, and Science Attitudes

OTHER STUDENT CHARACTERISTICS

The correlations of all other student characteristics with cognitive level, science achievement and science attitudes are reported in Table 18. The comparisons of age, IQ total and reading with these student performances are complete. For the other categories, fewer than three studies were found, and results are not reported.

In Table 19, the breakdowns by grade and subject appear. Again, only those areas with three or more studies are reported. Note that the student characteristics that made up the combined ability variables are reported in this table.

Definitions of student characteristics follow.

Age Correlations

Positive correlations on this predictor indicate that older students are associated with high scores on the criterion. When younger students scored higher on items, a negative correlation is recorded.

Anxiety Correlations

Anxiety was investigated in a very limited number of studies. A positive correlation indicates a student has great anxiety for a particular science subject or outcome measure.

Arithmetic Ability Correlations

Measures of basic arithmetic skills were incorporated into this category. Excepted were studies which compared higher math skills or SAT Math with student science performances. High scores in arithmetic ability correlate positively with high science outcomes.

Attitude Toward School Correlations

Attitude toward school was investigated by few studies that compared this factor with science outcomes. Positive attitude toward school when related to high achievement on science outcomes yields a positive correlation.

Attitude Toward Science Correlations

Attitudes toward science is a category of various science attitude measures. A positive correlation indicates a positive attitude toward science related to high achievement on other science outcomes.

Cognitive Level Correlations

Cognitive level represents studies dealing with Piagetean Stage as related to various science outcomes. Measures of Piagetean level include paper and pencil measures, small group interviews, and individualized assessments of Piagetean skills. Higher level Piagetean abilities relate positively to high achievement on science outcomes.

Homework Correlations

The predictor homework is defined as the amount of time spent by students studying at home. A positive correlation represents more time spent studying. For this predictor, only one study was found.

IQ Correlations

IQ correlation includes various measures of general intelligence. This was most often based on available high school records, the Lorge-Thorndike or Otis-Quick Score intelligence measures. A positive correlation with the criterion measure indicates a higher measured intelligence.

IQ Non-Verbal Correlations

"IQ non-verbal" measures are similar to those defined in the previous section on IQ correlations. However, this includes only the mathematically-oriented portions or forms of those tests. The correlation direction is defined as with IQ correlation.

IQ Verbal Correlations.

"IQ verbal" measures are similar to those defined in the previous section on IQ correlations. However, this includes only the non-mathematical oriented portions or forms of those tests. The correlation direction is defined as with IQ correlations.

Interest Correlations

Interest was measured on a number of tests of interest in science. Strong interest in science is positively related to high performance on other science outcome measures.

Internality Correlations

Internality correlations come from various measures of locus of control. A positive correlation represents an internal locus of control related to high performance on science outcome measures.

Language Correlations

Language is defined as those language skills measured by instruments other than those included in studies on IQ verbal and SAT verbal. High scores on the language measure correlate positively with high scores on the performance measures.

Math Ability Correlations

Math ability includes those mathematical skills measured by instruments other than those on arithmetic skills, IQ non-verbal and SAT non-verbal tests. Positive correlations with the performance measures represent a higher score on the math ability measure.

Motivation Correlations

Motivation in science was investigated only in one study and at the elementary school level. High motivation relates positively to high achievement with a science outcome.

Number of Science Courses Taken Correlations

"Science courses" was a measure of the number of science courses taken by student prior to involvement in a study. A positive correlation denotes a greater number of science courses taken.

Reading Correlations

Reading represents any measure of reading skills. Positive correlations with the performance measures indicate greater skills in reading.

SAT Math Correlations

"SAT Math" includes all studies involving math ability as measured by the Scholastic Aptitude Test when compared to measures of science outcomes. High SAT Math score and high scores on science outcomes are positively correlated.

SAT Verbal Correlations

"SAT Verbal" incorporates all studies investigating the relationship of verbal ability as measured by the Scholastic Aptitude Test and student outcomes in science. A positive correlation is in favor of a high score on the SAT when compared to high science outcomes.

Science Background Correlations

"Science background" is a rather loosely-defined characteristic. It is sometimes measured by survey data and other times by school records or actual measures of science background. Generally it is trying to determine how many and what kinds of science-related activities students have been exposed to other than in science classes. This includes a wide variety of activities, such as visiting museums and zoos, tinkering, reading of science-related books, etc. A positive correlation indicates a greater number of science-related activities.

Self Concept Correlations

Self concept was investigated by several studies using various measures of student self concept. A high self concept is positively related to high scores on science outcome measures.

Spatial Ability Correlations

Spatial ability was defined by various measures of student spatial ability. A positive correlation indicates a strong spatial ability when related to high scores on science performance.

Study Skills Correlations

Study skills combined various measures of study habits. Self-reported measures of amount of time spent studying and questionnaires asking information concerning good and bad study habits were included. Good study habits or more time spent studying related positively to high scores on science measures.

TABLE 18

CORRELATIONS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

	Combined Cognitive Level	Cognitive Level (Bloom)	Cognitive Level (Piaget)	Science Achievement	Science Attitudes
Age	r*=.24 s*=.25 N*=33	r=.29 s=.23 N=14	r=.20 s=.13 N=6	r=.15 s=.18 N=15	r=.07 s=.22 N=6
Anxiety	INSUFFICIENT STUDIES				
Arithmetic Ability	r=.52 s=.26 N=8	r=.37 s=.09 N=5	Insufficient Studies	r=.77 s=.27 N=3	No Data
Attitude Toward School	Insufficient Studies		No Data	Insufficient Studies	No Data
Attitude Toward Science	r=.32 s=.24 N=11	Insufficient Studies	Insufficient Studies	r=.23 s=.22 N=7	Insufficient Studies
Cognitive Level	r=.55 s=.10 N=8	r=.51 s=.11 N=4	No Data	r=.59 s=.06 N=3	Insufficient Studies
Homework	INSUFFICIENT STUDIES				
IQ Total	r=.44 s=.21 N=69	r=.47 s=.18 N=30	r=.44 s=.25 N=6	r=.42 s=.22 N=27	r=.16 s=.11 N=11
IQ Nonverbal	r=.55 s=.08 N=8	r=.56 s=.05 N=5	No Data	Insufficient Studies	Insufficient Studies
IQ Verbal	r=.57 s=.17 N=8	r=.63 s=.11 N=5	No Data	Insufficient Studies	Insufficient Studies

*See Table 8

TABLE 18 con't

CORRELATIONS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES

	Combined Cognitive Level	Cognitive Level (Bloom)	Cognitive Level (Piaget)	Science Achievement	Science Attitudes
Interest	r*=.06 s*=.03 N*=6	r=.08 s=.02 N=3	No Data	Insufficient Studies	
Internality	r=.50 s=.24 N=4	Insufficient Studies	No Data	Insufficient Studies	
Language	r=.52 s=.15 N=13	r=.57 s=.12 N=8	Insufficient Studies	r=.38 s=.19 N=5	No Data
Math Ability	r=.45 s=.19 N=15	r=.51 s=.01 N=3	No Data	r=.41 s=.20 N=11	r=.09 s=.28 N=3
Motivation		INSUFFICIENT STUDIES			
Science Background		INSUFFICIENT STUDIES			
Number of Science Courses Taken	r=.24 s=.13 N=8	r=.20 s=.07 N=7	Insufficient Studies		Insufficient Studies
Reading	r=.44 s=.29 N=21	r=.36 s=.19 N=6	r=.40 s=.29 N=3	r=.26 s=.40 N=14	r=.13 s=.23 N=3
SAT Math	r=.36 s=.12 N=3	INSUFFICIENT DATA			No Data
SAT-Verbal	r=.43 s=.09 N=3	INSUFFICIENT STUDIES			No Data
Self Concept	r=.24 s=.16 N=8	r=.18 s=.13 N=3	No Data	r=.29 s=.19 N=4	Insufficient Studies
Spatial Ability	r =.44 s =.22 N =5	r=.29 s=.16 N=3	No Data	Insufficient Studies	No Data
Study Skills	r=.51 s=.14 N=9	r=.50 s=.14 N=7	INSUFFICIENT STUDIES		

*See Table 8

TABLE 19

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

AGE (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
Elementary School (K-6)	r* = .30 s* = .19 N* = 16	r = .20 s = .15 N = 8	Insufficient Studies
Middle School (7-9)	r = .42 s = .33 N = 7	Insufficient Studies	Insufficient Studies
High School (10-12)	r = .01 s = .12 N = 9	r = .02 s = .14 N = 5	r = -.02 s = .08 N = 3
Elementary Science	r = .26 s = .23 N = 18	No Data	Insufficient Studies
General Science	r = .33 s = .30 N = 5	Insufficient Studies	Insufficient Studies
ARITHMETIC ABILITY (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .42 s = .04 N = 5	Insufficient Studies	No Data
Chemistry	r = .56 s = .29 N = 3	-NO DATA-	
ATTITUDE TOWARD SCIENCE (BY GRADE & SUBJECT)			
High School (10-12)	r = .34 s = .27 N = 6	r = .20 s = .27 N = 3	Insufficient Studies
General Science	r = .48 s = .23 N = 3	No Data	Insufficient Studies
Chemistry	r = .27 s = .23 N = 3	No Data	Insufficient Studies

*See Table 8

TABLE 19 (cont.)

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

COGNITIVE OF DEVELOPMENT (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
Elementary School (K-6)	r* = .53 s* = .11 N* = 5	Insufficient Studies	No Data
Elementary Science	r = .50 s = .14 N = 3	No Data	No Data
General Science	r = .61 s = .03 N = 3	No Data	No Data
IQ (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .42 s = .20 N = 27	r = .24 s = .14 N = 8	r = .19 s = .12 N = 3
Middle School (7-9)	r = .43 s = .19 N = 14	r = .59 s = .13 N = 5	r = .12 s = .13 N = 5
High School (10-12)	r = .46 s = .24 N = 19	r = .44 s = .23 N = 11	r = .21 s = .08 N = 3
Elementary Science	r = .38 s = .20 N = 29	No Data	r = .12 s = .16 N = 4
General Science	r = .54 s = .20 N = 9	No Data	Insufficient Studies
Life Science	r = .49 s = .24 N = 4	No Data	r = .22 s = .04 N = 4
Physical Science	r = .54 s = .19 N = 4	No Data	No Data
Chemistry	r = .42 s = .22 N = 5	No Data	No Data

*See Table 8

TABLE 19 (con't)

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

IQ NONVERBAL (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
Elementary School (K-6)	r* = .52 s* = .09 N* = 5	Insufficient Studies	Insufficient Studies
IQ VERBAL (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .58 s = .21 N = 4	Insufficient Studies	Insufficient Studies
High School (10 - 12)	r = .52 s = .12 N = 3	Insufficient Studies	No Data
Chemistry	r = .56 s = .07 N = 3	Insufficient Studies	Insufficient Studies
INTEREST (BY GRADE & SUBJECT)			
Middle School (7 - 9)	r = .06 s = .03 N = 6	Insufficient Studies	No Data
Physical Science	N = .06 s = .04 N = 4	Insufficient Studies	No Data
LANGUAGE ABILITY (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .54 s = .17 N = 9	r = .28 s = .26 N = 3	No Data
Elementary Science	r = .48 s = .31 N = 3	No Data	No Data

*See Table 8

TABLE 19 (con't)

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

LANGUAGE ABILITY (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
Elementary School (K-6)	r* = .54 s* = .17 N* = 9	r = .28 s = .26 N = 3	NO DATA
Elementary Science	r = .48 s = .31 N = 3	NO DATA	NO DATA
MATH ABILITY (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .53 s = .28 N = 3	INSUFFICIENT	STUDIES
High School (10-12)	r = .45 s = .13 N = 10	r = .43 s = .15 N = 7	Insufficient Studies
Elementary Science	r = .42 s = .19 N = 3	NO DATA	Insufficient Studies
Physical Science	r = .44 s = .10 N = 3	Insufficient Studies	Insufficient Studies
# OF SCIENCE COURSES TAKEN (BY GRADE & SUBJECT)			
High School (10-12)	r = .18 s = .09 N = 6	NO DATA	r = .03 s = .08 N = 3
READING ABILITY (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .35 s = .30 N = 11	r = .26 s = .40 N = 5	INSUFFICIENT STUDIES

*See Table 8

TABLE 19 (con't)

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

READING ABILITY (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
Middle School (7-9)	r* = .62 s* = .27 N* = 5	r = .62 s = .26 N = 4	Insufficient Studies
High School (10-12)	r = .43 s = .25 N = 5	r = .47 s = .29 N = 4	Insufficient Studies
Elementary Science	r = .34 s = .32 N = 9	NO DATA	Insufficient Studies
General Science	r = .62 s = .34 N = 4	NO DATA	Insufficient Studies
Life Science	r = .70 s = .12 N = 3	NO DATA	NO DATA
Chemistry	r = .35 s = .15 N = 3	NO DATA	NO DATA
SELF CONCEPT (BY GRADE & SUBJECT)			
Middle School (7-9)	r = .36 s = .15 N = 3	r = .36 s = .15 N = 3	NO DATA
High School (10-12)	r = .19 s = .14 N = 4	NO DATA	Insufficient Studies
Life Science	r = .36 s = .11 N = 4	Insufficient Studies	Insufficient Studies

*See Table 8

TABLE 19 (con't)

BREAKDOWNS OF RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH MEASURES OF COGNITIVE LEVEL, SCIENCE ACHIEVEMENT, AND SCIENCE ATTITUDES BY GRADE LEVELS AND SUBJECT AREAS

SPATIAL ABILITY (BY GRADE & SUBJECT)	COMBINED COGNITIVE LEVEL	SCIENCE ACHIEVEMENT	SCIENCE ATTITUDES
High School (10-12)	r* = .44 s* = .22 N* = 5	INSUFFICIENT STUDIES	NO DATA
STUDY SKILLS (BY GRADE & SUBJECT)			
Elementary School (K-6)	r = .54 s = .11 N = 5	INSUFFICIENT STUDIES	NO DATA
Elementary Science	r = .52 s = .20 N = 4	NO DATA	INSUFFICIENT STUDIES

*See Table 8

OTHER STUDENT PERFORMANCE RESULTS

The grid which follows, Table 21, illustrates student characteristics/ performance topics for which coding of science education studies was possible. Results are thenpresented alphabetically by category of student performance in Table 22. The reader is cautioned to carefully study the results, as some areas have only one or two studies and large standard deviations.

Studies in which students' race or gender was compared with some science outcome are reported as effect sizes and as correlations. All other results are correlations. Deltas and r's should not be compared. In some cases, the number of studies for which deltas and correlations are reported for an area of student performance do not agree. Without knowing the number of subjects of a gender or race, it is not possible to calculate Δ.

Researchers in this area are encouraged to fill in the blanks on the grid or conduct more research in areas where the number of codeable studies was low.

SUMMARY

Combined Cognitive Level.

The student characteristics that appear to be the best predictors of cognitive level performance in science are Cognitive Level and IQ-nonverbal (r=.55). Other variables with high correlations are Language Ability (combined, .53), Arithmetic Ability (r=.53), Mathematical Ability (combined, .51), Study Skills (.51), Internality (.50) and General Ability (.47).

At the elementary school level, the best indicators of a student's cognitive science outcome are IQ-verbal (.58), Language Ability (combined, .55), Study Skills (.54), Cognitive Level of Development (.53) and IQ-nonverbal (.52). Reading Ability (.62) and Language Ability (combined, .59) were the highest correlations for junior high school pupils in this area of performance. For the senior high school age IQ-verbal correlated .52 with combined cognigive level, followed by Language Ability (combined, .47), General Ability and IQ total (.46), and Spatial Ability (.44).

Student characteristics which seem to be good predictors of cognitive level by subject area appear in Table 20.

Table 20

Highest Correlations Between Student Characteristics and Combined Cognitive Level, Breakdown by Subject Areas

	Arithmetic Ability	Cognitive Level of Development	General Ability	IQ	IQ-Verbal	Language Ability	Mathematical Ability	Reading Ability	Study Skills
Elementary Science	X	.50	X	X	X	.53	X	X	.52
General Science	X	.61	X	.54	X	.70	.60	.62	X
Life Science	X	X	.47	.49	X	X	X	.70	X
Physical Science	X	X	X	.54	X	.55	.48	X	X
Chemistry	.56	X	X	.42	.56	X	X	X	X

Cognitive Level (Bloom)

The student characteristics with the strongest relationships to cognitive science measures were IQ verbal (.63), language ability and IQ non-verbal (.56), cognitive level (.51) and general ability (.48).

Cognitive Level (Piaget)

IQ (.44), reading ability (.40), general ability (.38) and language ability (.30) give the best indication of student performance in this area.

Science Achievement

The best predictor of this combined category of student'sscience grades and science achievement test scores is arithmetic ability (.77). Cognitive level (.59), general ability (.43), math ability and IQ (.42), and language ability (combined, .41) also have moderate correlation with science achievement.

In the grade level breakdowns, general ability had the strongest relationships with combined science achievement. Elementary, middle and secondary school correlations are .25, .59 and .47, respectively.

Science Attitudes

Compared with other correlations of student characteristics with their performances, those with science attitudes appear low. IQ (.16), general ability (.15) and reading ability (.13) were the high correlations in this area. When analyzed by grade and science subject area, the best predictor is general ability. The correlations follow, grade level: elementary (.14), middle (.12), secondary (.21); science subject: elementary science (.12), general science (.24) and life science (.22).

Gender and Race

One's sex and the societal and environmental influences regarding it and one's race are poor indicators of science performance.

Race: ANGLO/BLACK has more influence than sex on cognitive and science achievement outcomes, but the correlation comparing race: ANGLO/HISPANIC or BLACK/HISPANIC are about the same or smaller.

In some cases, gender is as good a predictor of students' science attitudes as any other student characteristics. Males at the elementary school level or in general science classes seem more likely to have more favorable attitudes than females in the same grade or class. (Correlations equal .10 and .14, respectively.)

Conclusion

This report summarizes the information currently available concerning the relationship of student characteristics with student performance. Other student characteristics and performances were investigated and appear in Appendix C. While interesting relationships between student characteristics and performance were found, it should be kept in mind that these differences are not always consistent across grade levels and school subjects. In many cases too few studies have been conducted to develop breakdowns of interest. Areas where few studies are available, such as the relationship of student characteristics with student attitudes and with Piagetean development, indicate some possibly fruitful areas for future research.

TABLE 21

GRID OF STUDENT CHARACTERISTICS WITH STUDENT PERFORMANCE MEASURES

Student Characteristics \ Student Performance	affective level	attitude toward method or system	attitude toward science and the scientist	attitude toward science class, instruction, or school	change in achievement	cognitive level: knowledge	cognitive level: understanding/comprehension	cognitive level: application	cognitive level: higher level skills	cognitive level (Piaget)	creativity	critical thinking ability	decision making skills	problem solving skills	process skills	psychomotor/manipulative skills	science achievement: grades	science achievement: test measures	science background	science interest	self concept
age			X	X		X	X	X		X				X	X	X		X			
anxiety																		X			
arithmetic ability						X	X			X							X				
attitude toward school																		X			
attitude toward science				X		X	X			X		X			X			X			
cognitive level of development			X			X	X				X	X						X			
gender	X		X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X
homework																		X			
IQ		X	X	X		X	X	X	X	X	X	X	X	X	X			X	X	X	X
IQ non-verbal			X			X									X	X	X				
IQ verbal			X			X		X							X	X	X				
interest				X			X	X	X			X						X			
internality			X	X		X		X									X	X			
language ability						X	X		X	X				X		X		X			
math ability			X			X	X							X				X		X	
motivation																		X			
number of science courses taken			X	X		X	X	X	X	X								X			
Race: Anglo-Black			X	X		X	X	X	X				X		X			X	X	X	X
Race: Anglo-Hispanic			X	X		X	X	X	X	X			X		X		X	X	X	X	X
Race: Black-Hispanic			X	X		X	X	X	X				X		X			X	X	X	X
Race: Other-Anglo			X	X		X	X	X	X				X		X			X	X	X	X
Race: Other-Black			X	X		X	X	X	X				X		X			X	X	X	X
Race: Other-Hispanic			X	X		X	X	X	X				X		X			X	X	X	X
reading ability			X			X	X		X					X			X			X	
SAT scores: math						X			X									X			
SAT scores: verbal						X			X									X			

Table 21 (cont.)

tudent haracteristics	Student Performance affective level	attitude toward method or system	attitude toward science and the scientist	attitude toward science class, instruction, or school	change in achievement	cognitive level: knowledge	cognitive level: understanding/comprehension	cognitive level: application	cognitive level: higher level skills	cognitive level (Piaget)	creativity	critical thinking ability	decision making skills	problem solving skills	process skills	psychomotor/manipulative skills	science achievement: grades	science achievement: test Measures	science background	science interest	self concept
science background			X			X			X									X		X	
elf concept			X				X	X	X						X			X			
socioeconomic tatus (SES)			X	X		X	X	X	X	X			X	X	X			X	X	X	X
atial ability						X	X											X			
study skills			X			X	X		X	X							X				

TABLE 22

RELATIONSHIPS OF STUDENT CHARACTERISTICS WITH OTHER MEASURES OF STUDENT PERFORMANCE

STUDENT PERFORMANCE: AFFECTIVE LEVEL

Student Characteristic		
Gender	r = .1600	Δ = .2240
	s = 0	s = 0
	N = 1	N = 1

ATTITUDE TOWARD METHOD OR SYSTEM

IQ	r	= .2000
	s	= 0.
	n	= 1.

ATTITUDE TOWARD SCIENCE AND THE SCIENTIST

Age		r	= -.0120
		s	= .1252
		n	= 5.
Cognitive Level of Development			
		r	= -.1700
		s	= 0.
		n	= 1.
Gender	r=.0400	Δ	= .0880
	s=.1360	s	= .1634
	N=14	n	= 10.

TABLE 22

ATTITUDE TOWARD SCIENCE AND THE SCIENTIST (cont.)

STUDENT CHARACTERISTICS

IQ	r = .2100	
	s = .0636	
	n = 5.	
IQ Verbal	r = .0700	
	s = 0.	
	n = 1.	
IQ Non-Verbal	r = .0300	
	s = 0.	
	n = 1.	
Internality	r = .3200	
	s = 0.	
	n = 1.	
Math Ability	r = .2150	
	s = .2475	
	n = 2.	
Number of Science Courses Taken	r = .5800	
	s = 0.	
	n = 1.	
Race: Anglo- Black	r = .0500	Δ = .1150
	s = .0141	s = .0212
	N =2.	N =2.
Race: Anglo-Hispanic	r = .0150	Δ = .0650
	s = .0071	s = .0354
	N =2.	N= 2.

TABLE 22 (cont)

STUDENT PERFORMANCE: ATTITUDE TOWARD SCIENCE AND THE SCIENTIST (CONT.)

Race: Black-Hispanic	r = -.0250	Δ = -.0600
	s = .0071	s = .0283
	N = 2.	N = 2.
Race: Other-Anglo	r = -.0050	Δ = -.0300
	s = .0071	s = 0.
	N = 2.	N = 2.
Race: Other-Black	r = .0250	Δ = -.0900
	s = .0071	s = .0141
	N =2.	N = 2.
Race: Other-Hispanic	r = .0250	Δ = .0350
	s = .0212	s = .0354
	N =2.	N =2.
Reading Ability	r = .2200	
	s = .2404	
	n = 2.	
Science Background	r = .1000	
	s = 0.	
	n = 1.	
Self Concept	r = .2600	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = -.0667	
	s = .1102	
	n = 3.	
Study Skills	r = .5200	
	s = 0.	
	n = 1.	

TABLE 22 (con't)

STUDENT PERFORMANCE: ATTITUDE TOWARD SCIENCE CLASS, INSTRUCTION, OR SCHOOL

STUDENT CHARACTERISTICS		
Age	r = .4600 s =0. n =1.	
Attitude Toward Science	r = .5700 s =0. n =1.	
Gender	r = .0630 s = .1296 N = 10.	Δ = .1189 s = .2330 N = 9.
IQ	r = .1800 s = .1273 n =2.	
Interest	r = .4100 s =0. n =1.	
Internality	r = .2600 s =0. n =1.	
Number of Science Courses Taken	r= -.0500 s= 0. n= 1.	
Race: Anglo-Black	r = -.0167 s = .0379 n = 3.	Δ = -.0433 s = .0945 N = 3.
Race: Anglo-Hispanic	r = .0067 s = .0289 n =3.	Δ = -.0167 s = .0666 N = 3.

TABLE 22 (con't)

STUDENT PERFORMANCE: ATTITUDE TOWARD SCIENCE CLASS, INSTRUCTION OR SCHOOL (CON'T)

STUDENT CHARACTERISTICS		
Race: Black-Hispanic	r = .0100	Δ = .0267
	s = .0700	s = .1514
	n =3.	N =3.
Race: Other-Anglo	r = -.0167	Δ = -.0167
	s = .0569	s = .1601
	n = 3.	N = 3.
Race: Other-Black	r = -.0067	Δ = - .0300
	s = .0208	s = .0755
	n = 3.	N = 3.
Race: Other-Hispanic	r = .0000	Δ = 0.
	s = .1311	s = .2193
	n = 3.	N = 3.
Socioeconomic Status	r = .1033	
	s = .0252	
	n = 3.	
CHANGE IN ACHIEVEMENT		
Gender	r = .0800	Δ = .1120
	s = 0.	s = 0.
	n = 2.	N = 2.
COGNITIVE LEVEL - KNOWLEDGE		
Age	r = .2071	
	s = .2641	
	n = 7.	
Arithmetic Ability	r = .4100	
	s = .0440	
	n = 4.	

TABLE 22 (con't)

STUDENT PERFORMANCE: COGNITIVE LEVEL - KNOWLEDGE

Attitude Toward Science	r = .1600 s = 0. n = 1.	
Cognitive Level of Development	r = .5900 s = 0. n = 1.	
Gender	r = .0606 s = .1411 n =18.	Δ = .0633 s = .2136 N = 12.
IQ	r = .4992 s = .2005 n =13.	
IQ Non-Verbal	r = .5600 s = .0515 n = 5.	
IQ Verbal	r = .6700 s = .0668 n = 4.	
Internality	r = .7000 s = 0. n = 1.	
Language Ability	r = .5483 s = .1111 n = 6.	
Math Ability	r = .5150 s = .0071 n = 2.	

TABLE 22 (con't)

STUDENT PERFORMANCE: COGNITIVE LEVEL - KNOWLEDGE (continued)

Student Characteristic		
Number of Science Courses Taken	r = .2900	
	s = 0.	
	n = 1.	
Race: Anglo-Black	r = .1500	Δ = .3733
	s = 0.	s = .0306
	n = 3.	N = 3.
Race: Anglo-Hispanic	r = .0633	Δ = .2733
	s = .0153	s = .0569
	n = 3.	N = 3.
Race: Black-Hispanic	r = -.0100	Δ = -.0100
	s = .1058	s = .2272
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0267	Δ = -.0800
	s = .0379	s = .0917
	n = 3.	N = 3.
Race: Other-Black	r = .1367	Δ = .2933
	s = .0961	s = .1102
	n = 3.	N = 3.
Race: Other-Hispanic	r = .1167	Δ = .1933
	s = .0569	s = .0351
	n = 3.	N = 3.
Reading Ability	r = .3833	
	s = .2098	
	n = 3.	
SAT Scores: Math	r = .2300	
	s = 0.	
	n = 1.	

TABLE 22 (con't)

STUDENT PERFORMANCE: COGNITIVE LEVEL - KNOWLEDGE (cont.)

SAT Scores: Verbal	r = .3300	s = 0.	n = 1.
Science Background	r = .0900	s = .0849	n =2.
Socioeconomic Status	r = .3717	s = .2083	n =6.
Spatial Ability	r = .2950	s = .1909	n =2.
Study Skills	r = .5850	s = .0661	n =4.

COGNITIVE LEVEL - COMPREHENSION

Age	r = .3375	s = .1926	n = 4.
Arithmetic Ability	r = .2200	s = 0.	n = 1.
Attitude Toward Science	r = .2400	s = 0.	n = 1.
Cognititive Level of Development	r = .4867	s = .1405	n = 3.

TABLE 22 (continued)

Student Performance: COGNITIVE LEVEL - COMPREHENSION (cont)

Student Characteristics		
Gender	r = .0745 s = .0795 n = 11.	Δ = .1778 s = .0638 N = 9.
IQ	r = .4300 s = .1771 n = 8.	
Interest	r = .0700 s = 0. n = 1.	
Language Ability	r = .5200 s = 0. n = 1.	
Math Ability	r = .4900 s = 0. n = 1.	
Number of Science Courses Taken	r = .2900 s = .0424 n = 2.	
Race: Anglo-Black	r = .1475 s = .0695 n = 4.	Δ = .3000 s = .1030 n = 4.
Race: Anglo-Hispanic	r = .0600 s = .0265 n = 3.	Δ = .2500 s = .0985 N = 3.

TABLE 22 (continued)

Student Performance: COGNITIVE LEVEL - COMPREHENSION (cont)

Student Characteristics		
Race: Black-Hispanic	r = -.0367	Δ = -.0733
	s = .0231	s = .0462
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0567	Δ = -.1467
	s = .0723	s = .0551
	n = 3.	N = 3.
Race: Other-Black	r = .0400	Δ = .2367
	s = .1058	s = .0757
	n = 3.	N = 3.
Race: Other-Hispanic	r = .0533	Δ = .1633
	s = .1266	s = .0306
	n = 3.	N = 3.
Reading Ability	$\bar{X}$ = .2200	
	s = .0566	
	n = 2.	
Self Concept	$\bar{X}$ = .2500	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = .1825	
	s = .1150	
	n = 4.	
Spatial Ability	r = .2800	
	s = 0.	
	n = 1.	
Study Skills	r = .3350	
	s = .1344	
	n = 2.	

TABLE 22 (continued)

STUDENT PERFORMANCE: COGNITIVE LEVEL - APPLICATION

Student Characteristics		
Age	r = .4200	
	s = .0889	
	n = 3.	
Gender	r = .1175	Δ = .2100
	s = .0845	s = .1661
	n = 8.	N = 8.
IQ	r = .4283	
	s = .0875	
	n = 6.	
IQ Verbal	r = .4500	
	s = 0.	
	n = 1.	
Interest	r = .0700	
	s = 0.	
	n = 1.	
Internality	r = .5200	
	s = 0.	
	n = 1.	
Number of Science Courses Taken	r = .1167	
	s = .0513	
	n = 3.	
Race: Anglo-Black	r = .1767	Δ = .4333
	s = .0153	s = .0586
	n = 3.	n = 3.
Race: Anglo-Hispanic	r = .0800	Δ = .3300
	s = .0100	s = .0520
	n = 3.	N = 3.
Race: Black-Hispanic	r = -.0533	Δ = -.1033
	s = .0015	s = .0473
	n = 3.	N = 3.

TABLE 22 (continued)

STUDENT PERFORMANCE: COGNITIVE LEVEL - APPLICATION (cont)

Student Characteristics		
Race: Other-Anglo	r = -.0467	Δ = -.1533
	s = .0473	s = .0709
	n = 3.	N = 3.
Race: Other-Black	r = .0833	Δ = .2800
	s = .0306	s = .0917
	n = 3.	N = 3.
Race: Other-Hispanic	r = .1033	Δ = .1767
	s = .0586	s = .0451
	n = 3.	N = 3.
Self Concept	r = -.0200	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = .3250	
	s = .1498	
	n = 4.	
COGNITIVE LEVEL - HIGHER LEVEL SKILLS		
Gender	r = .0533	Δ = .0983
	s = .0582	s = .1165
	n = 6.	N = 6.
IQ	r = .5467	
	s = .1380	
	n = 3.	
Interest	r = .0900	
	s = 0.	
	n = 1.	
Language Ability	r = .7600	
	s = 0.	
	n = 1.	
Number of Science Courses Taken	r = .1800	
	s = 0.	
	n = 1.	

TABLE 22 (continued)

STUDENT PERFORMANCE: COGNITIVE LEVEL - HIGHER LEVEL SKILLS (cont.)

Student Characteristics		
Race: Anglo-Black	r = .1900	Δ = .5067
	s = .0245	s = .0874
	n = 4.	N = 3.
Race: Anglo-Hispanic	r = .0900	Δ = .3867
	s = .0173	s = .0451
	n = 3.	n = 3.
Race: Black-Hispanic	r = -.0167	Δ = -.0533
	s = .0586	s = .1457
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0433	Δ = -.0967
	s = .0681	s = .1443
	n = 3.	N = 3.
Race: Other-Black	r = .1600	Δ = .4167
	s = .0346	s = .1955
	n = 3.	N = 3.
Race: Other-Hispanic	r = .1800	Δ = .2967
	s = .1803	s = .1950
	n = 3.	N = 3.
Reading Ability	r = .5800	
	s = 0.	
	n = 1.	
Science Background	r = .1500	
	s = 0.	
	n = 1.	
Self Concept	r = .2800	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = .3100	
	s = .1071	
	n = 4.	
Study Skills	r = .5200	
	s = 0.	
	n = 1.	

TABLE 22 (continued)

STUDENT PERFORMANCE: COGNITIVE LEVEL (PIAGET)

Student Characteristics				
Age	r =	.1967		
	s =	.1302		
	n =	6.		
Arithmetic Ability	r =	.1000		
	s =	0.		
	n =	1.		
Attitude Toward Science	r =	.3100		
	s =	0.		
	n =	1.		
Gender	r =	.1325	Δ =	-.0550
	s =	.2310	s =	.4455
	n =	4.	N =	2.
IQ	r =	.4367		
	s =	.2511		
	n =	6.		
Language Ability	r =	.2300		
	s =	.1697		
	n =	2.		
Number of Science Courses Taken	r =	.4100		
	s =	0.		
	n =	1.		
Race: Anglo-Hispanic	r =	.2200	Δ =	.4400
	s =	0.	s =	0.
	n =	1.	N =	1.
Reading Ability	r =	.4033		
	s =	.2909		
	n =	3.		
SAT Scores: Math	r =	.6000		
	s =	0.		
	n =	1.		
SAT Scores: Verbal	r =	.4300		
	s =	0.		
	n =	1.		
Socioeconomic Status	r =	.3200		
	s =	0.		
	n =	1.		

TABLE 22 (continued)

STUDENT PERFORMANCE: COGNITIVE LEVEL (PIAGET) (cont.)

Student Characteristics		
Study Skills	r = .1000 s = 0. n = 1.	
CREATIVITY		
Cognitive Level of Development	r = .3100 s = 0. n = 1.	
IQ	r = .1600 s = .0566 n = 2.	
CRITICAL THINKING ABILITY		
Attitude Toward Science	r = .6000 s = 0. n = 1.	
Cognitive Level of Development	r = .5800 s = 0. n = 1.	
Gender	r = .0267 s = .1966 n = 3.	Δ = -.0233 s = .3495 N = 3.
IQ	r = .3967 s = .1507 n = 6.	
Interest	r = .0700 s = 0. n = 1.	
DECISION MAKING SKILLS		
Gender	r = -.0400 s = .0572 n = 4.	Δ = -.0750 s = .1075 N = 4.

TABLE 22 (continued)

STUDENT PERFORMANCE: DECISION MAKING SKILLS (cont)

Student Characteristics		
IQ	r = -.0400	
	s = 0.	
	n = 1.	
Race: Anglo-Black	r = .2333	Δ = .6067
	s = .0751	s = .2230
	n = 3.	N = 3.
Race: Anglo-Hispanic	r = .2033	Δ = .2846
	s = .1966	s = .1966
	n = 3.	N = 3.
Race: Black-Hispanic	r = -.0600	Δ = -.1100
	s = .0700	s = .1353
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0333	Δ = -.2500
	s = .0153	s = .0954
	n = 3.	N = 3.
Race: Other-Black	r = .0667	Δ = .2300
	s = .1021	s = .3629
	n = 3.	N = 3.
Race: Other-Hispanic	r = .1433	Δ = .2267
	s = .0321	s = .0513
	n = 3.	N = 3.
Socioeconomic Status	r = .4500	
	s = .1992	
	n = 3.	
	PROBLEM SOLVING SKILLS	
Age	r = .7300	
	s = 0.	
	n = 1.	
Gender	r = .0100	Δ = .2000
	s = .2516	s = .6223
	n = 3.	N = 2.
IQ	r = .7100	
	s = .1838	
	n = 2.	

TABLE 22 (continued)

STUDENT PERFORMANCE: PROBLEM SOLVING SKILLS (CONT)

Student Characteristics		
Math Ability	r = .6700	
	s = 0.	
	n = 1.	
Reading Ability	r = .6400	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = .1900	
	s = 0.	
	n = 1.	
	PROCESS SKILLS	
Age	r = .2900	
	s = .5285	
	n = 3.	
Attitude Toward Science	r = .6200	
	s = 0.	
	n = 1.	
Gender	r = -.0037	Δ = .0557
	s = .1176	s = .0862
	n = 8.	N = 7.
IQ	r = .3967	
	s = .3482	
	n = 3.	
IQ Non-Verbal	r = .6100	
	s = 0.	
	n = 1.	
IQ Verbal	r = .7300	
	s = 0.	
	n = 1.	
Race: Anglo-Black	r = .1667	Δ = .2334
	s = .0513	s = .0513
	n = 3.	N = 3.

TABLE 22 (CONTINUED)

STUDENT PERFORMANCE: PROBLEM SOLVING SKILLS (CONT.)

Student Characteristics			
Race: Anglo-Hispanic	r = .0967 s = .0115 n = 3.	Δ = .4100 s = .0300 N = 3.	
Race: Black-Hispanic	r = -.0167 s = .0751 n = 3.	Δ = -.0033 s = .1290 N = 3.	
Race: Other-Anglo	r = -.0600 s = .0700 n = 3.	Δ = -.1767 s = .0681 N = 3.	
Race: Other-Black	r = .1600 s = .1418 n = 3.	Δ = .3267 s = .1210 N = 3.	
Race: Other-Hispanic	r = .1833 s = .0603 n = 3.	Δ = .2333 s = .0802 N = 3.	
Self Concept	r = .2600 s = 0 n = 1	Socioeconomic Status	r = .3300 s = .0829 n = 4

PSYCHOMOTOR/MANIPULATIVE SKILLS

Age	r = -.0150 s = .1061 n = 2.	
Gender	r = -.0300 s = 0. n = 1.	Δ = -.0500 s = 0. N = 1.
IQ Nonverbal	r = .2300 s = 0. n = 1.	
IQ Verbal	r = .3100 s = 0. n = 1.	
Language Ability	r = .2500 s = 0. n = 1.	

TABLE 22 (continued)

STUDENT PERFORMANCE: PSYCHOMOTOR/MANIPULATIVE SKILLS (cont.)

Student Characteristics		
Math Ability	r = .3000	
	s = 0.	
	n = 1.	
	SCIENCE ACHIEVEMENT - GRADES	
Arithmetic Ability	r = .7667	
	s = .2673	
	n = 3.	
IQ	r = .2833	
	s = .1222	
	n = 3.	
IQ Non-Verbal	r = .5050	
	s = .1626	
	n = 2.	
IQ Verbal	r = .3600	
	s = .1273	
	n = 2.	
Internality	r = .6200	
	s = 0.	
	n = 1.	
Language Ability	r = .5750	
	s = .0919	
	n = 2.	
Race: Anglo-Hispanic	r = .2300	Δ = .4700
	s = 0.	s = 0.
	n = 1.	N = 1.
Reading Ability	r = .6433	
	s = .2702	
	n = 3.	
Study Skills	r = .5300	
	s = .2121	
	n = 2.	

TABLE 22 (cont.)

STUDENT PERFORMANCE: SCIENCE ACHIEVEMENT - TEST MEASURES

Student Characteristics		
Age	r = .1507	
	s = .1806	
	n = 15.	
Anxiety	r = -.3000	
	s = 0.	
	n = 1.	
Attitude Toward School	r = .2100	
	s = .0849	
	n = 2.	
Attitude Toward Science	r = .2314	
	s = .2239	
	n = 7.	
Cognitive Level of Development	r = .5933	
	s = .0569	
	n = 3.	
Gender	r = .0898	Δ = .1622
	s = .1521	s = .3169
	n = 49.	N = 45.
Homework	r = .7400	
	s = 0.	
	n = 1.	
IQ	r = .4400	
	s = .2382	
	n = 24.	
Interest	r = .0150	
	s = .0212	
	n = 2.	
Internality	r = .1500	
	s = 0.	
	n = 1.	

TABLE 22 (cont.)

STUDENT PERFORMANCE: SCIENCE ACHIEVEMENT - TEST MEASURES (cont.)

Student Characteristics		
Language Ability	r = .3633 s = .1943 n = 3.	
Math Ability	r = .4127 s = .2014 n = 11.	
Motivation	r = .3600 s = 0. n = 1.	
Number of Science Courses Taken	r = .4800 s = 0. n = 1.	
Race: Anglo-Black	r = .1620 s = .0733 n = 15.	Δ = .4060 s = .1734 N = 15.
Race: Anglo-Hispanic	r = .0831 s = .0773 n = 13.	Δ = .2646 s = .1294 N = 13.
Race: Black-Hispanic	r = -.0142 s = .0772 n = 12.	Δ = -.0217 s = .1360 N = 12.
Race: Other-Anglo	r = -.0192 s = .0312 n = 12.	Δ = -.0808 s = .0901 N = 12.
Race: Other-Black	r = .1083 s = .0737 n = 12.	Δ = .2617 s = .1323 N = 12.
Race: Other-Hispanic	r = .1233 s = .0394 n = 12.	Δ = .1865 s = .0365 N = 12.
Reading Ability	r = .4100 s = .3444 n = 11.	

TABLE 22 (cont)

STUDENT PERFORMANCE: SCIENCE ACHIEVEMENT - TEST MEASURES (CONT)

Student Characteristics		
SAT Scores: Math	r = .4300 s = .0283 n = 2.	
SAT Scores: Verbal	r = .4850 s = .0071 n = 2.	
Science Background	r = .2300 s = 0. n = 1.	
Self Concept	r = .2875 s = .1903 n = 4.	
Socioeconomic Status	r = .2486 s = .0941 n = 21.	
Spatial Ability	r = .6550 s = .0212 n = 2.	
	SCIENCE BACKGROUND	
Gender	r = .1000 s = .0573 n = 6.	Δ = .2560 s = .1819 N = 5.
IQ	r = .3400 s = .1697 n = 2.	
Race: Anglo-Black	r = .1033 s = .0321 n = 3	Δ = .2533 s = .0929 N = 3.
Race: Anglo-Hispanic	r = .0600 s = .0100 n = 3.	Δ = .2533 s = .0929 N = 3.

TABLE 22 (cont)

STUDENT PERFORMANCE: SCIENCE BACKGROUND (CONT)

Student Characteristics		
Race: Black-Hispanic	r = 0.	Δ = 0.
	s = .0173	s = .0436
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0467	Δ = -.1800
	s = .0379	s = .0400
	n = 3.	N = 3.
Race: Other-Black	r = 0.	Δ = .0367
	s = .0500	s = .1266
	n = 3.	N = 3.
Race: Other-Hispanic	r = .0200	Δ = .0233
	s = .0800	s = .1050
	n = 3.	N = 3.
Socioeconomic Status	r = .2750	
	s = .0988	
	n = 4.	

SCIENCE INTEREST

Gender	r = .0863	Δ = .0025
	s = .2524	s = .3995
	n = 8.	N = 8.
IQ	r = -.0250	
	s = .1061	
	n = 2.	
Math Ability	r = -.1600	
	s = 0.	
	n = 1.	
Race: Anglo-Black	r = -.0233	Δ = .2767
	s = .0929	s = .8023
	n = 3.	N = 3.
Race: Anglo-Hispanic	r = .0233	Δ = .0933
	s = .0321	s = .1358
	n = 3.	N = 3.

TABLE 22 (CONT)

SCIENCE PERFORMANCE: SCIENCE INTEREST (CONT.)

Science Characteristics		
Race: Black-Hispanic	r = .0600	Δ = .1500
	s = .0458	s = .1114
	n = 3.	N = 3.
Race: Other-Anglo	r = -.0067	Δ = .0200
	s = .0451	s = .2081
	n = 3.	N = 3.
Race: Other-Black	r = -.0033	Δ = -.0367
	s = .0416	s = .1626
	n = 3.	N = 3.
Race: Other-Hispanic	r = .0600	Δ = .1067
	s = .1000	s = .1861
	n = 3.	N = 3.
Reading Ability	r = -.0400	
	s = 0.	
	n = 1.	
Science Background	r = .0300	
	s = 0.	
	n = 1.	
Socioeconomic Status	r = .0200	
	s = .1512	
	n = 4.	
	SELF CONCEPT	
Gender	r = .0800	Δ = .1600
	s = .0829	s = .1192
	n = 4.	N = 4.
IQ	r = .2300	
	s = 0.	
	n 1.	
Race: Anglo-Black	r = .0167	Δ = .0433
	s = .0231	s = .0635
	n = 3.	N = 3.

TABLE 22 (CONT)

STUDENT PERFORMANCE: SELF CONCEPT (CONT)

Student Characteristics		
Race: Anglo-Hispanic	r = .0167	Δ = .0667
	s = .0115	s = .0635
	n = 3.	N = 3.
Race: Black-Hispanic	r = .0300	Δ = .0200
	s = .0000	s = .0693
	n = 3.	N = 3.
Race: Other-Anglo	r = .0500	Δ = .1100
	s = .0200	s = .0436
	n = 3.	N = 3.
Race: Other-Black	r = .0433	Δ = .1567
	s = .0208	s = .0971
	n = 3.	N = 3.
Race: Other-Hispanic	r = .1033	Δ = .1700
	s = .0681	s = .0954
	n = 3.	N = 3.
Socioeconomic Status	r = .0567	
	s = .0379	
	n = 3.	

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A CONSOLIDATION AND APPRAISAL OF SCIENCE META-ANALYSES

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A CONSOLIDATION AND APPRAISAL OF SCIENCE META-ANALYSIS

The results of several separate but coordinated meta-analyses of science education research have been reported in the previous chapters. All the meta-analyses were conducted as part of one project focused upon the research questions receiving the most attention in the extant science education literature. This chapter is directed to consolidating information on selected matters addressed in two or more of the separate meta-analyses and to examining the relationship between the results of these meta-analyses and other work of this nature conducted by other researchers.

A MACRO- OR MICRO- VIEW?

Meta-analysis can be applied to broad or narrow topics. In this project, most of the questions were quite broad. For example, one meta-analysis was directed at the full range of science curriculum reform projects of the third quarter of this century, not just the results of studies of one particular curriculum or even one general type. In another instance, instructional systems in general were examined, not just one or two of the twelve systems included in this category. In a similar manner, all of the topics were broad and potentially included many facets which individually could have been the focus of a meta-analysis. Only in two instances (Lott, 1982 and Sweitzer, 1982) was a broad topic narrowed somewhat because of the large number of studies potentially encompassed by the original question posited. Thus, the predominant pattern in this science meta-analysis project has been to take a macro-view rather than a micro-view.

The macro-view was taken to gain an overview of the results of science education research; answers were desired at this level of generality. In addition, the macro-approach can, in principle at least, encompass all the subquestions that may be found within the broader topic. The practical limitation on this dual level approach may result from the need to sample the literature on the broad topic simply because it is too large to search out and analyze in its entirety. What we know about sampling gives us confidence in this approach with respect to the braoder questions, but it does mean that the number of studies examined with respect to some sub-question may be quite small. As a result, one may not be able to draw decisive conclusions about the sub-question even though information on the broad question is quite definitive.

The practical result of this situation for some of the major questions addressed herein is that the subquestion information may be somewhat limited. In other instances the subquestion information may be quite complete, particularly in those cases where it was feasible to search out and analyze essentially all the literature on the question. Other times the subquestion information is very limited due to the sampling approach cited above and/or the limited number of extant studies on the topic.

The implications of limited subquestion information, where it exists, will vary among subquestions and the particular individuals having an interest in them. A researcher may view the information on a particular subquestion as an indication that it is a fruitful area for further empirical research, or an indication that the area is not very interesting. In this instance, limited subquestion information may be sufficient. On the other hand, a person interested in conducting a meta-analysis on such a subquestion may decide to search out a more extended data base for the given subquestion; either by locating the additional extant studies on the topic as defined or by expanding the question, such as by adding other subject areas in addition to science. The practitioner seeking guidance for educational practice from a meta-analysis may or may not have substantial information to guide decision making, but has more than would have been available from simply examining the original studies themselves.

EXPERIMENTAL REACTIVITY

An examination of the total collection of meta-analyses conducted in this project shows a greater effect for experimental treatments than for control groups in the majority of cases, which raises the possibility of a pervasive Hawthorne effect throughout the studies in the literature. Seemingly all treatments have some impact; do we have to discount the results by some factor to allow for a bias due to reactive effects?

In general it seems that the amount of such discounting required is very little. First of all, it should be noted that some treatments did *not* produce a positive effect. Among instructional systems, for example, the media-based systems did not produce positive cognitive comparisons. And even instructional systems overall only produced an average effect size of .10 standard deviations.

In addition, review of the results of the curriculum project meta-analysis in this context may be useful. Substantial effect sizes were found even though most of these studies covered a lengthy period of time and often involved several teachers. In other words, the positive effects were present even though the conditions under which the studies were conducted would tend to attenuate the results if a Hawthorne effect were the cause.

In summary, there seems to be little reason to discount the overall positive effects of the meta-analyses of experimental studie in any substantial way because of an assumed Hawthorne effect.

CROSS-QUESTION COMPARISONS

The meta-analysis process produces extensive data on many independent variables. As a result there are a variety of topics for which useful data can be found in two or more of the seven separate meta-analyses conducted as part of this project. Several such topics will be discussed here including experimental characteristics of the studies, inquiry teaching, teaching process skills, teaching problem solving and critical thinking, teacher education, gender differences, and the number of variables used to describe a treatment.

Experimental Characteristics

Among the characteristics of the published research of possible interest are the quality of the studies, the form of publication and the year of publication. Any relationship between these characteristics and effect sizes has important implications for interpretation of the research results.

Quality of research studies. A concern often expressed about the process of meta-analysis is the possibility that research studies of both high and low quality will be mixed together resulting in conclusions which look valid in the aggregate but would not hold up if based only on the high quality studies. We have followed the argument (Glass, McGaw, and Smith, 1981) that judgments of the quality of research studies should be recorded and used in the final analysis to determine whether or not the studies of different levels of quality lead one to different conclusions. This approach is of considerable advantage in drawning conclusions from a relatively small subgroup of studies dealing with a particular independent variable not included in all the research studies on a particular topic. If the data of the meta-analysis indicates no sizable difference between those studies of high and low quality, there is a basis for using all studies of varying quality to increase the size of the sample of studies employed in addressing a particular independent variable. Variations in the effect size found among experimental studies of differing quality in this project are reported in Table I. In the main, the differences are not large and there has been opportunity to increase the sample size when examining various subquestions.

Publication Source. Another characteristic of interest is the form of publication, i.e. whether the publication source was a dissertation, journal article, unpublished document, or some other form. This characteristic is of particular interest because of its relationship to the literature search process and any possible bias resulting from using literature from one source more extensively than another.

Information pertaining to this issue is contained in Table I which shows the average effect size found for dissertations, journal articles and other forms of publication. It is apparent that for the most part journal articles contained larger effect sizes than dissertations and other sources. The apparent bias in journals toward publication of significant results has been noted previously (Glass, McGaw and Smith, 1981).

Year of publication. Another study characteristic with possible implications for the literature search process, is the year of publication. The data from the meta-analysis of science instructional systems (Willett and Yamashita, 1982) shows no discernable relationship between year of publication and effect size. Though not reported in the other chapters of this report, similar data was found in the other meta-analyses of this project.

Size of the Study. Although probably of no significance for the literature search process, it may be well to note here the apparent relationship between the number of people involved in a study and the effect size obtained. Wise and Okey (1982) reported in their meta-analysis a mean effect size of .66 when the

Table I

Average Effect Size for Experimental Studies by Publication Source and Quality of Study for Each Research Site and the Composite of Sites

	Publication Source				Quality of Study (Internal Validity)			
		$\bar{\Delta}$	s	n		$\bar{\Delta}$	s	n
Site I[4]	D	.34	.61	243	H	.38	.33	25
	J	.30	.59	63	M	.33	.68	205
	O	.37	.81	35	L	.35	.56	110
Site II[5]	D	.06	.38	214	H	.11	.45	117
	J	.20	.48	96	M	.17	.41	132
	O	.13	.40	31	L	.01	.36	92
Site III[6]	D	.32	.66	230	H	.42	.65	137
	J	.41	.67	105	M	.32	.64	235
	O	.30	.51	74	L	.07	.56	28
Site IV[7]	D	.31	.89	467	H	.39	1.06	242
	J	2.08	.60	116	M	.17	.61	243
	O	--	--	--	L	.53	.59	59
Site V[8]	D	.59	.77	84	H	.82	.98	68
	J	1.20	1.79	62	M	.75	.82	54
	O	.76	.22	8	L	1.02	2.46	26
Composite	D	.29		1238	H	.39		589
	J	1.11*		442	M	.28		869
	O	.31		148	L	.31		315

$\bar{\Delta}$ = average effect size
s = standard deviation of effect size
n = number of effect sizes

D = Dissertations
J = Journal articles
O = Other

H = High internal validity
M = Medium internal validity
L = Low internal validity

*If site IV is eliminated, then $\bar{\Delta} = .48$ based on 326 cases.

number of subjects was 50 or less. In each of their larger size categories the average effect size was progressively less with the average for 200 or more subjects being only .09. Sweitzer (1982) reported that the number of teachers involved in a teacher education study correlated negatively (significant at .05 level) with effect size. Wise and Okey (1982) also report decreasing mean effect sizes with increasing numbers of teachers involved in conducting the treat (e.g., $\bar{\Delta}$ - .41 for 1 or 2 teachers and $\bar{\Delta}$ - .20 for 9 or more teachers). The overall picture one obtains from the meta-analyses is of less difference between experimental and control groups as the number of people involved increases.

Inquiry teaching

Inquiry teaching has been a prevalent aspect of the science education literature of the last quarter century. Defined in varied ways, it has been a persistent theme and appears in many aspects of the meta-analyses. Pertinent information from four of the meta-analyses is discussed here and, in general, provides a positive vote for inquiry teaching.

The first is the meta-analysis of curriculum projects (Shymansky, Kyle, and Alport, 1982) in which 105 studies of supposedly inquiry-oriented curricula were analyzed. These curricula produced mean effect sizes (when compared to traditional curricula) of approximately one-third standard deviation across all types of outcome measures. This support for inquiry teaching is impressive. One must still face the question, however, of whether or not inquiry teaching and the NSF-sponsored curricula can be equated. It would seem that if inquiry teaching were the distinguishing characteristic of these curricula, those with the highest degree of inquiry would have the highest effect sizes. When in fact they analyzed the data in this manner they found essentially no correlation ($r = .05$) between student achievement and the degree of inquiry as determined by expert ratings of the inquiry orientation of each of the curricula. While this information raises some doubt as to whether or not inquiry teaching is the distinguishing characteristic of these successful curricula, we are nonetheless left with information which supports to some extent at least, an inquiry approach.

A second meta-analysis (Wise & Okey, 1982) dealt with studies on specific teaching techniques including ones identified as inquiry-discovery. These techniques were "more student-centered and less step-by-step teacher directed learning" when compared to control groups. They found an average effect size in favor of inquiry-discovery of .41 based on 38 effect sizes obtained for cognitive outcomes. An average of .15 was obtained for 20 effect sizes on other outcomes. These were experimental studies where the independent variable was the teaching technique and we are not left with the definitional question just cited in the previous meta-analysis of curriculum programs. Again, we have positive data in support of inquiry teaching.

Another meta-analysis giving attention to the effect of inquiry teaching (Lott, 1982) compared inductive and deductive teaching approaches. "Educational experiences in which examples or observations were provided to students prior to formalizing generalizations were classified as inductive. Those studies where generalizations were formulated prior to any illustrative examples were characterized as deductive." Although still positive, the evidence in this meta-analysis is not strong. The overall composite effect size for inductive versus deductive approaches was only .06 in favor of the inductive approaches.

While this slight difference in favor of the inductive approach by itself is not consequential, further breakdown of the data hints a little more strongly in this direction. When divided according to the degree of teacher interaction, those labeled "direct" had a mean effect size of -.15 (n = 5) while those labeled indirect had a mean effect size of .24 (n = 13). This data tends to support an approach having characteristics often attributed to an inquiry orientation. Yet another breakdown was according to the level of inquiry. Of the studies in this particular meta-analysis, 12 were classified as having a low level of inquiry and 5 as having a medium level of inquiry. While the studies with a low level of inquiry did not achieve effect sizes quite as great as the other (.29 compared to .41) the differences are not large enough to be of much consequence. A third breakdown of the data was according to the level of guidance provided to the students. Those studies in which the approach was defined as "structured" produced an effect size of -.14 when compared to a control group (n = 8) while those identified as "guided exploration" produced an effect size of .43 (n = .15). While the magnitude of the evidence in support of what may be designated inquiry teaching in this meta-analysis is not dramatic, it clearly is in the positive direction.

A final meta-analysis which is relevant to the question at hand is the one conducted on studies of teacher education. While conducted in a somewhat different context (teacher education), the data is still relevant and again points in the same positive direction. Various teacher education studies were classified according to type of instruction. Many fell in a general classification indicating there was not specific information about the instructional approach. Others, however, were classified into one of three categories: traditional, inquiry or discovery. The latter two were considered synonymous in the meta-analysis report but were maintained as separate categories simply because of the label used by the authors of the original studies. The traditional approaches produced a mean effect size of .30 (n = 5) while the approaches designated as inquiry in nature had a mean effect size of .63 (n = 9) and those labeled discovery had a mean effect size of .40 (n = 7). In this instance the evidence is fairly clearcut in favor of the non-traditional approaches.

In summary it can be said that all of the data from these meta-analyses favors an inquiry approach although the evidence varies in its strength from one meta-analysis to another.

Teaching process skills

Another consideration found in several of the meta-analyses is the teaching of process skills or methods of scientific investigation. An examination of this facet of the meta-analyses provides information on the extent to which these matters can be taught and even the extent to which they can be taught by various teaching approaches. The study of curriculum programs (Shymansky, Kyle and Alport, 1982) indicates that the NSF-sponsored curriculum programs were clearly successful in this regard. Compared to control classes, students in these new programs averaged .39 standard deviations higher than the control groups. Breaking the data down more finely indicates an average effect size of .61 for learning specific techniques and an average effect size of .17 for learning the methods of science. Not surprisingly, those curriculum programs rated as placing high emphasis upon process skills produced higher effect sizes than those rated as being low in this regard (.50 compared to .12).

While the meta-analysis of science teaching systems contained specific attention to science methods as a learning outcome, most studies analyzed did not include this variable. Since the number of studies pertaining to one particular learning system and giving attention to this variable usually was quite small, there is not much basis for extensive discussion of the relative merits of the various teaching systems in this regard. It is worthy of note, however, that the average effect size of this outcome variable on all systems combined was .47, compared to an average effect size of .10 for cognitive outcomes under these same systems. This learning outcome can be successfully accomplished.

In the meta-analysis of inductive versus deductive teaching, process skills produced an average effect size of .29 compared to a composite effect size on all outcome variables of only .06. This result is similar to that found with teaching systems and provides further support for the speculation that direct attempts to teach this outcome have a high probability of success when pursued appropriately.

It is also of interest that certain teacher characteristics may be positively associated with success in teaching process skills to students. While the correlation coefficients were very low, the meta-analysis of science teacher characteristics (Druva, 1982) hints at a positive relationship between success in teaching process skills and self-abasement in a teacher, high number of science courses taken by the teachers, and low achievement orientation, self-concept, and political and theoretical values on the part of the teacher.

Teaching, problem solving and critical thinking

The situation with respect to problem solving and critical thinking is similar to that reported above for process skills. The NSF-sponsored curriculum programs (Shymansky, Kyle & Alport, 1982), resulted in larger outcomes in this realm than did the control groups (average effect size = .25). In the meta-analysis of teaching systems (Willett & Yamashita, 1982), those studies in which this outcome was measured showed greater success for the various teaching systems than with the control groups. As in the case of process skills, the teaching systems produce substantially larger differential outcomes for these variables than for cognitive outcomes. Finally, the meta-analysis conducted by Wise & Okey (1982) also showed that these outcomes were taught more successfully with various teaching strategies than with the control groups. In summary, it can be said that problem solving and critical thinking were more successfully with various teaching strategies than with the control groups and. They were successfully taught using the new curricula, teaching systems and a variety of teaching strategies.

Teaching education

In addition to the meta-analysis on teacher education itself, two others provide data pertaining to this topic. Information from these meta-analyses will be discussed here with respect to three aspects of teacher education: science courses, education courses, and institutes.

With respect to science training, relevant data is found in three of the meta-analyses. The integration of studies on teacher education (Sweitzer, 1982), showed that of the various "organizational patterns", science courses had larger effect sizes than those reported for all other "organizational patterns" when compared to control groups. Similarly, the meta-analysis of science teacher characteristics (Druva & Anderson, 1983) showed positive correlations between science training and student learning. Whether the outcomes were cognitive, process skills, or affective outcomes, the number of science courses was related. While the absolute correlation coefficients were not very high, they were among the higher correlations found between student outcomes and teacher characteristics. In summary, science training stands high among teacher characteristics and those facets which make up a teacher education program.

Similarly, training in professional education *per se* is important. While not quite as high as science courses, the effect size for methods courses, when compared to a control, were very substantial ($\overline{\Delta} = .79$). In the meta-analysis of teacher characteristics, the number of education courses and the student teaching grade correlated more highly with teaching effectiveness than any other variable. Similarly, the correlation between student outcomes and education preparation were positive but somewhat less than the science preparation. While the correlation coefficients were very small they were larger than the coefficients for most other variables such as teacher personality, enthusiasm and attitudes. In summary, both science instruction and instruction in professional education are important in the preparation of teachers.

In view of their substantial popularity over the last quarter century, information on science institutes is of obvious interest. Data from the meta-analysis of the effects of new science curricula (Shymansky, Kyle & Alport, 1982) showed very clearly that those teachers teaching the new curricula who had no in-service preparation, such as institutes, did better than those who had such preparation. This surprising result compels one to look at other information and the other meta-analyses. Information from the meta-analysis of teacher education studies is not completely inconsistent with the above finding. While the effect sizes for institutes were positive they were less than those reported for methods courses or science courses. In the meta-analysis of science teaching characteristics, academic institutes showed a positive correlation with student cognitive achievement but its magnitude was not impressive. Judging by its reputation among practicing teachers, one might conclude that science teacher institutes were of unusually high value, possibly of more importance than their initial training. The research data does not lend a lot of credence to this reputation.

Gender Differences

When one examines the data on gender differences found in these several meta-analyses, the general indication is that they are very small, although there are a couple of potentially interesting variations within this general pattern. The study of teacher cahracteristics (Druva, 1982) showed essentially no relationship between teacher gender and teaching performance. For example, the correlation between "effective" teaching and teacher gender was only .04. A similar lack of relationship shows up in the comparison of inductive and deductive teaching (Lott, 1982). The difference in effect sizes between males and females was only .02 standard deviations. In the meta-analysis of student characteristics, the effect size difference between male and female students on various outcome measures range between .08 and .16 standard deviations.

The meta-analysis of student characteristics, however, did contain some interesting variations from this general pattern when broken down by subject area and level of schooling, the most noteworthy being the apparent greater differences in favor of males on cognitive and achievement measures in the middle school years as compared to the earlier and later years of schooling. One additional interesting but not easily explainable gender difference showed up in the meta-analysis on curriculum projects. The performance of students in classes of mixed gender was noticeably higher than in classes that were predominantly male or predominantly female. While this effect may be due to some intervening variable, this result deserves some further exploration.

Multiple variable treatments

In their meta-analysis report, Wise and Okey raise an issue for which pertinent data is found in one of the other meta-analyses. "It is interesting to imagine how several strategies, none of which has an overwhelming impact, might influence achievement if used in concert." While they had no data on such possibilities, one of the other meta-analyses, (Sweitzer, 1982) reports mean effect sizes with respect to the number of variables used to describe each treatment. Treatments having one and two variables have mean effect sizes of .67 and .65 respectively, essentially the same. Treatments described by three variables have a mean effect size of .73, however, and treatments described by four variables have a mean of 1.50 (n = 14). There seems to be reason for researchers and practitioners to consider the optimal application of combinations of treatments.

COMPARISON WITH OTHER META-ANALYSES

Since a number of meta-analyses of various facets of science education research have been conducted, there are instances where another meta-analysis deals with the same issues as some portion of the large-scale meta-analysis project being reported herein. As a result, it is possible to make comparisons between meta-analyses and gain some evidence as to the stability of this process for integrating the findings of research studies.

The need for making such comparisons is substantial since meta-analysis increasingly is being used to integrate and interpret research findings. This question is particularly important because definitions of the domain of studies involved and the meta-analysis procedures vary from one researcher to another. For example, one researcher may make use of the extensive dissertation literature as was done in the project reported herein, while another researcher will choose to use only published studies. Other variations include the span of publication years covered by the analysis or the countries in which the studies were conducted. Still other variations potentially could result from one researcher seeking all studies on a given topic while another samples the extant literature because of the large number of studies. The major question at hand is whether different meta-analyses will yield the same or similar conclusions in spite of these differences in the collection of research analyzed, variations in the definitions in the collection of research analyzed, variations in the definitions of coding categories, or even differences in the skill of the coders. In this section this question is addressed by comparing the results of the several meta-analysis in our project with the results of other researcher's meta-analyses which have addressed the same topic or portions of a topic.

Studies of the new science curricula

A recently reported meta-analysis (Weinstein, Boulanger, & Walberg, 1982) integrated studies of high school-level science curriculum programs. Although they defined their domain of studies to include those published in Great Britian and Israel as well as the U.S., and it includes only about half as many studies because of the way in which their universe of literature was defined, the results are strikingly similar. They found an overall mean effect size of 0.31 standard deviations based on 151 effect sizes derived from 33 studies. The Shymansky, Kyle and Alport (1982) work produced an overall mean effect size for junior high school studies of .31 and an effect size of .38 at the senior high school level based on nearly twice as many studies. In view of the differences in the span of years covered (1963-1978 vs. 1955-1980) and the differences in the countries of origin, these are very similar results.

Another meta-analysis at the secondary level which deserves comparison is a study of inquiry teaching in biology (El-Nemr, 1979). Since many of the inquiry biology courses compared with traditional courses in that meta-analysis used the BSCS biology materials, one would expect conclusions similar to those just cited for studies of the "new" curricula. This situation does in fact pertain. El-Nemr found an overall effect size of .36 for achievement (based on 12 studies) for these BSCS studies included within his studies of inquiry-oriented biology, while Shymansky, Kyle and Alport (1982) reported an average overall effect size of .59 for achievement (N = 29) from the NSF sponsored biology programs. El-Nemr's results also are consistent with the generally positive results about inquiry teaching from the Colorado

Science Meta-Analysis Project reported earlier.

At the elementary school level a similar comparison can be made with the work conducted by Bredderman (1982). When compared on a composite of all outcome measures Bredderman found an average effect size of .26 for the ESS program as compared to an average effect size of .37 reported by Shymansky, Kyle and Alport (1982). Similarly, the comparison for SAPA is .35 versus .27 and for SCIS the results are .34 versus .30 respectively. Again the results are strikingly similar. A note of caution must be introduced, however, in that when the categories are broken down further with resulting small sample sizes, there is more variation in the results. For example, when the outcome measure was science processes the comparisons were .19 and .47 for the ESS program, .71 versus 1.08 for the SAPA program and .43 versus .56 for the SCIS program. In the case of science content or science achievement as the outcome measure, the comparisons were .07 versus .09 for ESS, .08 versus .17 for SAPA, and .26 versus 1.00 for SCIS. Again the results are similar although the variations are somewhat greater. Whatever differences may exist in specific numbers, however, it is important to note that the differences are not large enough to result in the researcher coming to substantially different conclusions.

Instructional techniques

Making comparisons between meta-analyses conducted within this general category is more difficult because the various categories defined by the researchers are not the same. For example Boulanger (1981) had a category called pre-instructional strategies which included advance organizers, behavioral objectives and set induction. Wise and Okey (1982), on the other hand, had a category called focusing which included items such as objectives, and organizers of instruction, but it was defined to include the use of these techniques before, during or after instruction. Although specific comparisons are difficult to make in this instance, it is probably fair to note that the results of somewhat similar categories are in the same general direction and no major conflicts are evident. For example, the focusing category of Wise and Okey yielded an average effect size on cognitive measures of .48 while the pre-instructional strategies category of Bolanger yielded an average effect size of 1.03. Another example of a meta-analysis that cannot be compared directly is that of Yeany and Miller (1982). Their meta-analysis of diagnostic/ remedial instruction yielded an average effect size of .55. Some of the categories employed by Yamishita and Willet (1982) i.e. mastery learning and P.S.I. instructional systems) have some similarity even though they can not be directly compared. The fact that the effect sizes reported in these two meta-analyses are of the same order of magnitude, however, is encouraging with respect to the question about the stability of meta-analyses.

Direct comparisons are legitimate, however, in the case of meta-analyses of inductive versus deductive instruction in science. Lott (1982) reported an average effect size in the knowledge category of .02 while Bolanger reports an average effect size on cognitive outcomes as -.22 based on a relatively small number of cases. In the former case the effect size is essentially non-existent and in the latter instance the negative effect size is small enough that the authors are led to claim that they can draw "no firm conclusion."

Studies of advance organizers provide another instance in which comparisons can be made readily. Lott reported an average effect size of .24 on the composite measures of knowledge and its application. Luiten (1980) reported an average effect size of .21 for measures taken within one day of instruction and effect sizes ranging from .19 progressively to .38 on measures taken at longer and longer period of time from the immediate instruction. Kozlow and White (1980) did not report average effect sizes but did report results consistent with those cited above. They indicate that "of the 99 t-statistics computed, 68 were positive and 22 of these showed statistical significance beyond the 0.05 level. None of the negative t-statistics were significant at the 0.05 level. These results lend support to the claim that advance organizers do facilitate learning."

Teacher training.

Another instance where there is much commonality with another meta-analyses but where direct comparisons cannot be made with our project, is the integration of studies of strategy analysis on science teacher training approaches conducted by Yeany and Porter (1982) and that facet of the teacher education meta-analysis centered upon training techniques (Sweitzer, 1982). Each meta-analysis uses approximately the same number of categories but they are not directly comparable. The average effect sizes reported in each case range over approximately the same numerical span. They range upward from .65 in one instance and .67 in the other.

Student characteristics

Although the conceptual frameworks are quite different, relationships among several student characteristics reported in three different meta-analyses deserve comparison. In their work with students characteristics as part of the Colorado Science Meta-Analysis Project, Malone and Fleming (1982) report a correlation between general ability and science attitudes of .15, while Wilson (1981) reported a correlation of .16. In a meta-analysis where science attitudes were considered as an outcome measure, Boulanger (1981) reported a correlation between ability and attitude of .27.

The relationship between general ability and science achievement was considered in two of these meta-analyses. Malone and Fleming (1983) report a correlation of .30 while Boulanger (1981) reported a correlation of .48 between ability and cognitive outcomes. Another meta-analysis pertaining to student characteristics was conducted by Boulanger and Kremer (1981) but the results reported there cannot be compared directly with the meta-analyses reported herein.

Conclusion

In summary, it can be said that this comparison of the several meta-analyses conducted in the area of science education leads to the conclusion that the meta-analysis technique has a great deal of stability and is quite robust with respect to variations in results that potentially could be introduced by differences in definition of the topic at hand, research procedures employed, sampling of studies, and definitions of coding categories.

In this regard, a concern sometimes expressed about meta-analysis which should be addressed here is the possibility that a meta-analysis on a particular topic will not include all available studies and thus be biased and lead one to erroneous conclusions. This question is an important one in view of the fact that not all questions addressed within this particular meta-analysis project had a complete collection of the relevant research studies upon which to base a conclusion and this situation is characteristic of most meta-analyses conducted today (obviously a result of the logistics involved in doing the job). The encouraging news to report, however, is that the meta-analysis process seems to be quite robust in this regard; all indications are that a complete or random sampling of studies is not critical. In addition to the evidences just noted for this claim,reference should be made to the data reported in Table 1 which includes information about the factors one would most likely expect to enter the process as selection factors. Although there are some differences in the effect sizes reported for type of publication and quality of publication, one would generally come to similar conclusions in spite of variations of these two characteristics. Data collected on such matters as year of publication showed even less variation in average effect size.

SOME CONTENTS ON THE META-ANALYSIS PROCESS

After this extensive involvement in a lengthy meta-analysis project, it seems appropriate to make a few comments about the process itself and its role in the overall research endeavor.

Personal requirements

There are certain personal requirements on the part of the meta-analysis scholar which, although not absolutely essential, certainly will make this person's life easier. First, there must be an acceptance of long tedious hours committed to reading and coding research studies. While journal articles are much faster to code, it would appear that an average figure for doing a dissertation is about two and one-half hours. A second characteristic that will make a researcher's life easier is a tolerance for ambiguity. One can expect to find many gaps in the information reported in various research studies, and digging out information is often not only tedious but requires one to make assumptions and interpretations for translating data into a usable form. One must recognize that research studies often are not written with the complete and clear recording of data demanded by the meta-analysis process. But equally frustrating is the discovery that reported information is often difficult to find because of the organization of the report and failure to attend to such basic matters as labeling tables clearly.

Start with dissertations

At least in the field of science education, it is recommended that the starting point for a meta-analysis be the dissertations conducted on the topic. Though more difficult to acquire and more time-consuming to code, they contain a more complete record of data and are the best source when a study has been reported both as a dissertation and as a journal article.

Of great assistance to this project was the availability to us of the microfilm collection of science education dissertations maintained at the Science and Mathematics Education ERIC center at Ohio State University. The continued availability of this collection to researchers conducting meta-analysis work in the future would be of great benefit. One factor to bear in mind, of course, is the apparent selection factor operating in the publication process mentioned earlier whereby journal articles report research studies with larger differences between experimental and control groups.

Importance of meta-analysis

A final comment about meta-analysis concerns its importance to the research enterprise. The nature of research in the behavioral sciences, with its multiplicity of ill-controlled variables, is such that one experiences great difficulty in drawing definitive conclusions about what the research says. Meta-analyses are important if future research is to have focus and address the most significant questions. Meta-analysis also is of major importance for transmitting research conclusions to educational practitioners with confidence and the firm conviction that research does indeed say something to the teacher and administrator.

Further Use of the Project Data Base

The data file for the project is available on a computer tape for other researchers to use. A User's Manual has been prepared to aid anyone wishing to use the data file (Anderson and Kahl, 1982). For further information contact:

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Campus Box 249
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CONTENTS OF DATA FILES

File #1 - Curricular Programs

N of Cases: 341 Cards/Case: 2

Other Information: Decimal points are included in raw data where appropriate.

BACKGROUND AND CODING INFORMATION

Card	Column	Variable
1	1	Card Number (always "1")
	2-3	Reader Code (1st digit is site (always "1"); 2nd digit is coder)
	4-7	Study Code
	8-11	Comparison Code (e.g., "0102" indicates 1st of 2 comparisons important if same study yields more than one treatment - control comparison for same outcome variable)
	12-15	Outcome Code (e.g. "0102" indicates 1st of 2 outcome variables used from study)
	16-17	Date of Publication (last two digits of year)
	18	Form of Publication (1) Journal (2) Book (3) MA/MS Thesis (4) Dissertation (5) Unpublished
	19-20	Blank
		SAMPLE CHARACTERISTICS
	21	Grade Level (1) Primary: K-3 (2) Intermediate: 4-6 (3) Jr. High: 7-9 (4) Sr.High: 10-12 (5) Post Secondary
	22-25	Total Sample Size
	26-27	Length of Study (in weeks)
	28-29	Gender (% Female)
	30	Average Ability (1) Low (below 95 IQ) (2) Average (95-105) (3) High (above 105)
	31	Homogenity of IQ (1) Homogeneous (2) Heterogenous
	32	Source of IQ (1) Stated (2) Inferred
	33-34	Race (% non-white)
	35	Predominant Minority (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American (5) Black (6) Other
	36-37	% Predominant Minority
	38	SES (1) Low (2) Medium (3) High
	39	Homogeneity of SES (1) Homogeneous (2) Heterogeneous
		Secondary School Science Background
	40	Life Science (1) Yes (2) No
	41	Physical Science (1) Yes (2) No
	42	General Science (1) Yes (2) No
	43	Earth Science (1) Yes (2) No
	44	Biology (1) Yes (2) No
	45	Chemistry (1) Yes (2) No
	46	Physics (1) Yes (2) No

47 Handicapped (1) Visually impaired (2) Hearing impaired (3) Learning disability (4) Emotionally disturbed (5) Multiple handicaps

48-51 N of pupils in T_1 (Experimental)

52-55 N of pupils in T_2 (Control)

56-57 % Mortality T_1

58-59 % Mortality T_2

60 Special Grouping by Ability (1) Not grouped (2) Low track (3) Medium track (4) High track

61 Size of School (1) < 50 (2) 50-199 (3) 200-499 (4) 500-999 (5) 1000-1999 (6) > 2000

62 Type of Cummunity (1) Rural (2) Suburban (3) Urban

TREATMENT CHARACTERISTICS

63-64 Treatment Code:

Elementary Curricula
- 01 ESS
- 02 SCIS, SCIIS, SCIS II
- 03 S-APA
- 04 OBIS
- 05 ESLI
- 06 ESSENCE
- 07 COPES
- 08 MAPS
- 09 USMES
- 10 MINNEMAST
- 11 IS
- 12 SCII
- 13 Elementary School Training Program in Scientific Inquiry
- 14 Flint Hills Elementary Science Project

Junior High Curricula
- 30 ISIS
- 31 ISCS
- 33 IPS
- 34 ESCP
- 35 IME
- 36 Conservation Education/Environmental Education/Ecology
- 37 Montclair Science Project

Secondary Curricula
- 50 BSCS Special Materials
- 51 BSCS Yellow
- 52 BSCS Blue
- 53 BSCS Green
- 54 BSCS Advanced
- 55 CHEM Study
- 56 CBA
- 57 PSSC
- 58 Project Physics
- 59 Conservation Education/Environmental Education/Ecology
- 60 PSMS
- 61 IAC

Low High
Curriculum Profile (1 2 3 4)

65 Inquiry
66 Process Skills
67 Emphasis on Laboratory
68 Degree of Individualization
69 Emphasis on Content

Study Modification to Curriculum Profile (1) Modifications made toward "low" end of curriculum profile (2) No modifications made (3) Modifications made toward "high" end of curriculum profile

70 Inquiry
71 Process Skills
72 Emphasis on Laboratory
73 Degree of Individualization
74 Emphasis on Content

Technology Used

75 Hand Held calculators (1) Yes (2) No
76 Films (1) Yes (2) No
77 TV (1) Yes (2) No
78 Computer (1) Yes (2) No
79 Blank
80 Blank

CODING INFORMATION

Card	Column	Variable
2	1	Card Number (always "2")
	2-3	Reader Code (1st digit is site (always "1"); 2nd digit is coder)
	4-7	Study Code
	8-11	Comparison Code (e.g., "0102" indicates 1st of 2 comparisons important if same study yields more than one treatment-control comparison for same outcome variable)
	12-15	Outcome Code (e.g. "0102" indicates 1st of 2 outcome variables used from study)
		TEACHER CHARACTERISTICS
	16-17	% Female
	18-19	Average number of years of science teaching experience
	20-21	Average number of years teaching science curriculum T_1
	22-23	Average number of years teaching science curriculum T_2
	24-25	Race (% non-white)
	26	Predominant minority (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
	27-28	%Predominant Minority
	29	Educational Background (1) Less than Bachelors (2) Bachelors (3) Bachelors + 15 (4) Masters (5) Masters + 15 (6) Masters + 30 (7) Doctorate
	30	Was preservice training provided? (1) Yes (2) No
	31	Was inservice training provided? (1) Yes (2) No
	32	Was inservice training (1) locally funded and/or sponsored (2) university funded and/or sponsored (3) federally funded (4) information not provided

DESIGN CHARACTERISTICS

33 Assignment of S_s to treatment (1) Random (2) Matched (3) Intact (4) Self-selecting

34 Assignment of teachers to treatments (1) Random (2) Non-random (3) Self-selecting (4) Crossed (5) Matched

35 Unit of Analysis (1) Infividual (2) Classroom (3) School (4) Other group

36 Type of Study (1) Correlational (2) Quasi-Experimental (3) Experimental (4) Pre-Experimental

37 Rated internal validity (1) Low (intact; highly dissimilar) (2) Medium (random; or, intact with some threats) (3) High (random; low mortality)

OUTCOME CHARACTERISTICS

(Each Outcome Geta a Separate Coding Form)

38 Content of Measure (1) Life Science (2) Physical Science (3) General Science (4) Earth Science (5) Biology (6) Chemistry (7) Physics

39 Congruence of Measure with T_1 (1) Low (2) Medium (3) High

40 Congruence of Measure with T_2 (1) Low (2) Medium (3) High

41-42 Type of Criterion:

01 Cognitive -low
02 Cognitive -high
03 Cognitive -mixed/general achievement
04 Problem Solving
05 Affective -subject
06 Affective -science
07 Affective -procedure/methodology
08 Values
09 Process skills
10 Methods of science
11 Psychomotor
12 Critical thinking
13 Creativity
14 Decision making
15 Logical thinking (Piagetian)
16 Spatial relations (Piagetian)
17 Self-concept
18 Classroom behaviors (on task, etc.)
19 Reading
20 Mathematics
21 Social Studies
22 Communication skills

43 Criterion measured relates to (1) student performance (2) teacher performance

44 Method of measurement: (1) Standardized test (2) Ad hoc written test (researcher, project) (3) Classroom test (not including #1 or #2) (4) Observation (passive, instructional) (5) structural interview or assessment

45 Reactivity (1) Low (standardized test, etc.) (2) Medium (3) High (researcher has vested interest, i.e., attitude measure, etc.)

EFFECT SIZE CALCULATION

46-47 Source of Effect Size Data:
- 01 Directly from reported data or raw data (means and variances)
- 02 Reported with direct estimates (ANOVA, t, F)
- 03 Directly from frequencies reported on ordinary scale (Probit, X^2)
- 04 Backwards from variance of means with randomly assigned groups
- 05 Nonparametrics (other than #3)
- 06 Guessed from independent sources (test numbers, other students using same test, conventional wisdom)
- 07 Estimated from variance of gain scores (correlation guessing)
- 08 From probability level only (i.e. conservative estimate)

48 Source of Means: (1) unadjusted posttest (2) covariance adjusted (3) residual gains (4) pre,post-differences (5) Other

49 Reported Significance:
- 1 $p \leq .005$
- 2 $.005 < p \leq .01$
- 3 $.01 < p \leq .05$
- 4 $.05 < p \leq .10$
- 5 $p > .10$

50 Dependent Variable Units (1) grade-equivalent units (2) Other
51-53 Mean Difference in Grade Equivalent Units (decimal in column 52)
54 Have the group variances been observed individually? (1) Yes (2) No (if no, go to 76)
55-60* Ratio of experimental to control group variances
61-65* Effect size based on experimental group variance (A)
66-70* Effect size based on control group variance (B)
71-75* Average effect size based on (A) and (B)

*Decimal points are included in raw data. There are two places to the right of the decimal point for these five variables.

File #2 - Instructional Systems

N of Cases: 346 Cards/Case: 10

Other Information: Decimal points omitted -proper placement indicated where appropriate. See starred (*) variables from card #10

Card	Column	Variable
1	3-6	Study identification code
	7-8	Comparison code (numbered sequentially, important if same study compared more than one treatment group to control)
	9-10	Outcome code (numbered sequentially, important if same study used more than one outcome variable)
	11-14	Year in which study was reported
	15	Form in which study was reported (1) Journal article (2) Book (3) Master's thesis (4) Doctoral thesis (5) Unpublished article (6) Conference paper
2	1-2	Mean age of students in treatment group
	3-4	Modal grade of treatment group
	5-7	Average IQ of treatment group
	8	Source of treatment group IQ (1) Stated (2) Inferred
	9	Homogeneity of treatment group IQ (1) Homogeneous (2) Heterogeneous
	10-12	Percent female in treatment group
	13-15	Percent minority in treatment group
	16	Predominant minority in treatment group (1) Mexican (2) Other Hispanic (3) Asian (4) Native American (5) Black (6) Other
	17-19	Percent predominant minority in treatment group
	20	Mean socioeconomic status of treatment group (1) Low (2) Medium (3) High
	21	Homogeneity of treatment group SES (1) Homogeneous (2) Heterogeneous
	22	Treatment group handicap, if any (1) Vision impaired (2) Hearing impaired (3) Learning disabled (4) Emotionally disturbed (5) Multiple handicaps (6) Other
	23	Treatment group tracking (1) Not grouped (2) Low track (3) Medium track (4) High track
	24-26	Initial size of treatment group
	27-29	Final size of treatment group
	30	School size of treatment group (1) Less than 50 (2) 50 to 199 (3) 200 to 499 (4) 500 to 999 (5) 1000 to 2000 (6) More than 2000
	31	Community type of treatment group (1) Urban (2) Rural (3) Suburban
3		ON CARD 3 COLUMNS 1-31 CONTAIN THE SAME INFORMATION ON THE CONTROL GROUP THAT CARD 2 DOES ON THE TREATMENT GROUP. ON CARD 3, THE VARIABLE NAMES END WITH 2 INSTEAD OF 1 (e.g., COMM2).

Card	Column	Variable
4	1-2	Number of teachers in treatment group
	3-4	Mean teacher age in treatment group
	5-6	Treatment group teachers, average number of years of teaching
	7-8	Average number of years of science teaching
	9-10	Average number of years teaching this curriculum
	11-13	Percent female teachers in treatment group
	14-16	Percent minority teachers in treatment group
	17	Predominant minority of treatment group teachers (1) Mexican (2) Other Hispanic (3) Asian (4) Native American (5) Black (6) Other
	18-20	Percent predominant minority teachers in treatment group
	21	Educational background of treatment group teachers (1) Less than B.A. (2) B.A. only (3) B.A. + 15 units (4) M.A. only (5) M.A. + 15 unity (6) M.A. + 30 units (7) Doctorate
	22	Treatment group teacher inservice training prior to experiment (1) Low: one-shot (2) Medium: series of lectures or workshops (3) Specialization
	23	Training through NSF? (1) Yes (2) No
	24	Training obtained at university? (1) Yes (2) No
	25	Training obtained locally? (1) Yes (2) No
	26	Treatment group teachers' acceptance of philosophy (1) Low (2) Medium (3) High
	27	Assignment of students to treatment group (1) Stratified random (2) Random (3) Matched (4) Intact random (5) Intact nonrandom (6) Self-selected
	28	Assignment of teachers to treatment group (1) Random (2) Nonrandom (3) Self-selected (4) Crossed (5) Matched
	29	Treatment group rated internal validity (1) Low (intact, highly dissimilar) (2) Medium (random or intact, some threat) (3) High (random, low mortality)
	30	Treatment group unit of analysis (1) Individual (2) Classroom subgroup (3) Classroom (4) School (5) Other
	31	Type of study (1) Correlational (2) Quasi-Experimental (3) Experimental
5		ON CARD 5, COLUMNS 1-31 CONTAIN THE SAME INFORMATION ON THE CONTROL GROUP THAT CARD 4 DOES ON THE TREATMENT GROUP. ON CARD 5, THE VARIABLE NAMES END WITH 2 INSTEAD OF 1.
6	1	Subject matter in treatment group (1) General science (2) Life Science (3) Physical Science (4) Biology (5) Earth Science (6) Chemistry (7) Physics (8) Other
	2-3	Duration of treatment group program in weeks
	4-5	Time elapsed prior to testing, in weeks
	6-8	Minutes per week of treatment
	9-10	Frequency of testing, times permonth
	11	Treatment group fidelity to curriculum (1) Low (2) Medium (3) High
	12	Fidelity to treatment (1) Low (2) Medium (3) High
	13	Nature of implementation (1) Supplemental (2) Integral

	14	Behavioral objectives in treatment group (1) Used (2) Not used
	15	Self-paced in treatment group (1) Used (2) Not used
	16	Immediate feedback in treatment group (1) Used (2) Not used
	17	Diagnostic Testing and prescription in treatment group (1) Used (2) Not used
	18	Computer assisted instruction in treatment group (1) Used (2) Not used
	19	Computer managed instruction in treatment group (1) Used (2) Not used
	20	Computer simulated experiments in treatment group (1) Used (2) Not used
	21	Team teaching in treatment group (1) Used (2) Not used
	22	Teacher as tutor in treatment group (1) Used (2) Not used
	23	Pupil as tutor in treatment group (1) Used (2) Not used
	24	Individualized instruction in treatment group (1) Used (2) Not used
	25	Unit approach to instruction in treatment group (1) Used (2) Not used
	26	Departmentalized elementary school in treatment group (1) Used (2) Not used
	27	Source papers in treatment group (1) Used (2) Not used
	28	Traditional science classroom in treatment group (1) Used (2) Not used
7		ON CARD 7, COLUMNS 1-28 CONTAIN THE SAME INFORMATION ON THE CONTROL GROUP THAT CARD 6 DOES ON THE TREATMENT GROUP.
8	1-2	Average class size in treatment group
	3	Flexible modular scheduling in treatment group (1) Used (2) Not used
	4	Large group organization (1) Used (2) Not used
	5	Normal class grouping in treatment group (1) Used (2) Not used
	6	Small group organization (1) Used (2) Not used
	7	Group of 1 student (1) Used (2) Not used
	8	Laboratory activities in treatment group (1) Used (2) Not used
	9	Teacher demonstrations in treatment group (1) Used (2) Not used
	10	Student lab activities structured in treatment group (1) Used (2) Not used
	11	Student lab activities unstructured in treatment group (1) Used (2) Not used

	12	Nature of treatment group learning materials (1) Published (2) Modified published (3) Original
	13	Learning kits in treatment group (1) Used (2) Not used
	14	Linear programmed materials (1) Used (2) Not used
	15	Branched programmed materials (1) Used (2) Not used
	16	Programmed materials graded by reading level in treatment group (1) Used (2) Not used
	17	Self-directed study (1) Used (2) Not used
	18	Student-assisted instructional program (1) Used (2) Not used
	19	Media-based instruction (1) Television (2) Not used (3) Film (4) Teaching machines (5) Slides (6) Tapes
	20	Victor electrowriter (1) Used (2) Not used
	21	Mastery learning (1) Required (2) Not required
	22-24	Level of mastery required
	25	Teacher-directed remediation (1) Used (2) Not used
	26	Student-directed remediation (1) Used (2) Not used
	27	Keller Personalized System of Instruction (1) Used (2) Not used
	28	Audio-Tutorial (1) Used (2) Not used
	29	Contracts for learning (1) Used (2) Not used
9		ON CARD 9, COLUMNS 1-29 PROVIDE THE SAME INFORMATION ON THE CONTROL GROUP THAT CARD 8 DOES ON THE TREATMENT GROUP.
10	1-2	Type of outcome criterion: 01 Cognitive low (recall, comprehansion) 02 Cognitive hish (application) 03 Cognitive mixed/general achievement 04 Problem solving 05 Affective toward subject 06 Affective toward science 07 Affective toward procedure/method 08 Values 09 Process skills 10 Methods of science 11 Psychomotor (lab skills) 12 Critical thinking 13 Creativity 14 Decision making

15 Logical thinking
16 Spatial reasoning
17 Self-concept
18 Science perceptions

3 Congruence of measure with treatment program (1) Low (2) Medium (3) High

4 Congruence of measure with control program (1) Low (2) Medium (3) High

5 Method of measurement (type of instrument) (1) published, nationally available, standardized (2) Modification of national standardized (3) Ad hoc written tests (4) Classroom evaluation, excluding #1-3 (5) Observation (passive, unstructured) (6) Structured interview, assessment (7) Other

6 Reactivity of measure: (1) Low: cognitive meansure, one administration or long lag, not alterable (2) Medium (3) High: affective, transparent, alterable

7-8 Calculation of effect size:
  01 Directly from reported or raw data
  02 Reported with direct estimates (ANOVA, etc.)
  03 From frequencies reported on ordinal scales
  04 Backwards from other variances of means
  05 Nonparametrics (other than #3)
  06 Estimated from independent sources
  07 Estimated from variance (correlation guessing)
  08 Estimated from p-value
  09 From raw data with teacher (year) effects removed
  10 Other
  11 From percentiles

9 Source of means:
  1 Unadjusted posttest
  2 Covariance adjusted
  3 Residual gains
  4 Pre-post differences
  5 Other

10 Reported significance
  1 $p \leq .005$
  2 $.005 < p \leq .01$
  3 $.01 < p \leq .05$
  4 $.05 < p \leq .10$
  5 $p > .10$
  6 "not significant"

11 Dependent variable units (1) Grade-equivalent (2) Other

12-15 Mean difference in grade equivalent units

16 Group variances reported individually (1) Yes (2) No

17-20 Ratio of treatment to control group standard deviation

21-24	Effect size based on treatment group standard deviation
25-28	Effect size based on control group standard deviation
29-32	Average of ESE and ESC
33-36	Study Effect Size (same as effect size based on control group standard deviation when available; otherwise could be based on "pooled" standard deviation derived from t-scores, mean squares from ANOVA, etc.)

*No decimal points were printed on the raw data cards. The last two columns for each of these variables represent digits to the right of the decimal point. Users should take this into account by using the appropriate input format statements in their own computer routines. For negative values of these variables, the negative signs are printed on the raw data cards in the first of the four columns designated for those variables.

File #3 - Teaching Strategies

N of Cases: 411 Cards/Case: 2

Other Information: Decimals are not included in the raw data. Users must allow for them in their own input formats where appropriate.

Card	Column	Variable
		REPORT ID
1	1-2	Reader (31, 32, or 33)
	3-6	Study Code (numbered consecutively from 3001)
	7	Record ID (1 or 2 indicating 1st or 2nd card of case)
		STUDY DATA
	8-11	Comparison code (e.g., 0103 indicates 1st comparison of 3 obtained from study. If a study used 2 treatment and 1 control group, comparison would be possible.)
	12-15	Outcome code (e.g., 0102 indicates 1st dependent variable of 2 used from study)
	16-17	Year of study (69, 73, etc.)
	18	Form of study (1) Journal (2) Book (3) Master's Thesis (4) Dissertations (5) Unpublished
		STUDENT DATA
	19-20	Mean age to nearest year
	21-22	Grade level (00-kindergarten, 16-senior in college)
	23-25	Average IQ
	26	Homogeneity of IQ (1) Homogeoeous (2) Heterogeneous
	27	Source of IQ (1) Stated (2) Inferred
	28-29	Gender (% female) (00 to 99)
	30	High school science background: (current enrollment) 1 General science 2 Life science 3 Physical science 4 Biology 5 Earth science 6 Chemistry 7 Physics
	31-32	Race (%non-white)

33	Predominant minority race (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
34-35	% predominant minority
36	SES status (1) Low (2) Middle (3) High
37	Homogeneity of SES (1) Homogeneous (2) Heterogenous
38-40	Experience in program or method (days)
41	Handicapped (1) Visually impaired (2) Hearing impaired (3) Learning Disability (4) Emotionally disturbed (5) Multiple handicaps (6) Not handicapped
42	Special Grouping (1) Not grouped (2) Low track (3) Medium track (4) High track (5) Voluntary
43-45	Number of subjects
46-47	% Mortality

TEACHER DATA

48-49	Age
50-51	Experience teaching (# of years)
52-53	Experience teaching subject
54-55	Experience teaching curriculum
56-57	Race (% non-white)
58	Predominant minority race (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
59-60	% predominant minority
61-62	Gender (% female)
63-64	NSF training (%teachers with training)
65	Educational background (1) less than Bachelors (2) Bachelors (3) Bachelors + 15 or more (4) Masters (5) Masters + 15 or more (6) Masters + 30 or more (7) Doctorate
66-67	Number of teachers
68-69	Special training given (% teachers with training specialized for program or method)
70-71	Acceptance of philosophy (01) Low (02) Medium (03) High

CONTEXT CHARACTERISTICS

Card	Column	Variable
2	8	Size of school (1) < 50 (2) 50-199 (3) 200-499 (4) 500-999 (5) 1,000-2,000 (6) > 2,000
	9	Community type (1) urban (2) rural/town (3) suburban
	10-11	Class size (average # of students)

DESIGN CHARACTERISTICS

	12	Treatment fidelity measured (1) yes (2) no
	13	Assignment of Ss (1) random (2) matched (3) intact (4) voluntary
	14	Assignment of teachers (1) random (2) non-random (3) voluntary (4) crossed (5) matched
	15	Internal validity (1) low (2) medium (3) high
	16	Unit of analysis (1) individual (2) classroom (3) school (4) other
	17	Type of study (1) correlational (2) quasi-experimental (3) experimental

TREATMENT

	18-19	Strategy (1) questioning (2) wait-time (3) testing (4) on task (5) manipulative (6) presentation modes (7) inquiry (8) AV (9) teacher direction (10) other
	20-21	Duration (# of hours)
	22	Teacher role (1) presenter (2) manager (3) 1 plus 2 (4) consultant (5) passive (6) unknown
	23	Student role (1) receiver (2) direction follower (3) problem solver/analyzer/synthesizer (4) evaluator (5) other
	24	Task specificity (1) low (2) medium (3) high (4) unknown
	25-26	Focus of strategy (01) lab (02) non-lab (03) entire (04) out of class
	27	Questioning type (1) (2) (3) (4)
	28-29	Question level (% high)
	30	Wait time (1) after question (2) after response (3) both
	31	Wait time (SECS)

32	Testing frequency (# per week)
33	Testing type (1) test only (2) test + feedback (3) test + feedback + remedial (4) to mastery (5) pretest
34	Testing responsibility (1) student (2) teacher (3) joint
35	
36	On task technique (1) reinforcers (2) penalties (3) testing (4) clear purpose (5) verbal (6) other
37	Area (1) biology (2) chemistry (3) earth science (4) physical science (5) general science (6) other

OUTCOME CHARACTERISTICS

41-42	Type of criterion (1) cognitive low k-c (2) cognitive high AP (3) cognitive mixed/gen. ach. (4) problem solving (5) affective-subject (6) affective-procedure (7) affective-science (8) values (9) process skills (10) methods of science (11) psychomotor (12) critical thinking (13) creativity (14) decision making (15) logical thinking-Piaget (16) spatial reasoning (17) other
43	Method of measurement (1) published (2) ad hoc (3) classroom test (4) observation (5) structured interview (6) other
44-45	Criterion reliability (.00-.99 decimal not included)
46	Reactivity of criterion (1) low (2) medium (3) high

EFFECT SIZE CALCULATION

47-48	Source of effect size data (1) Directly from reported data or raw data (means & variances) (2) Reported with direct estimates (ANOVA, t, G) (3) Directly from frequencies reported on ordinal scale (Probit, X^2) (4) Backwards from variance of means with randomly assigned groups (5) Nonparametrics (other than #3) (6) Guessed from independent sources (test manuals, other students using same test, conventional wisdom) (7) Estimated from variance of gain scores (correlation guessing) (8) (9) (10) Other
49	Reported significance (1) $p \leq .005$ (2) $.005 < p \leq .01$ (3) $.01 < p \leq .05$ (4) $.05 < p \leq .10$ (5) $p > .10$
50	Dependent variable units (1) grade-equivalent units (2) other
51-53	

54	Have the group variances been observed individually? (1) Yes (2) No (if no, go to 8.0)
55-66	
67-70	Study effect size (sign in column 67, no decimal in raw data - users must allow for two digits to the right of decimal in their own input format statements)

File #4 - Nature and Structure of Content

N of Cases: 583 Cards/case: 6

Other Information: Missing values are coded as ⁻1 in raw data. Decimals not included. Users must allow for them in their own input formats where appropriate.

Card	Column	Variable	
1	1-2	ID01	Reader code
	3-6	ID02	Study code
	7-10	ID03	Comparison code
	11-14	ID04	Outcome code
	15-16	ID05	Year of study
	17-18	ID06	Form of study: (1) Journal (2) Book (3) Masters Thesis (4) Dissertations (5) Unpublished manuscript
			STUDENT CHARACTERISTICS
	19-20	SC01	Modal grade
	21-23	SC02	Ability level (IQ)
	24-25	SC03	Homogenity of IQ: (1) Homogeneous (2) Heterogeneous
	26-27	SC04	Source of IQ: (1) Stated (2) Inferred (3) Calculated
	28-30	SC05	Gender (% female)
	31-32	SC06	Highest level secondary school science: (1) general science (2) life science (3) physical science (4) biology (5) earth science (6) chemistry (7) physics
	33-35	SC07	Race (% non-white)
	36-37	SC08	Predominant race: (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
	38-40	SC09	% Predominant race
	41-42	SC10	SES: (1) Low (2) Low & Medium (3) Medium (4) Medium & High (5) High
	43-44	SC11	Homogeneity of SES: (1) Homogeneous (2) Heterogeneous
	45-46	SC12	Previous experience in program or method (wks.)
	47-48	SC13	Handicapped: (1) visually impaired (2) hearing impaired (3) learning disability (4) emotionally disturbed (5) multiple handicaps
	49-50	SC14	Special grouping: (1) not grouped (2) low track (3) medium track (4) high track (5) voluntary
	51-54	SC15	Class size (no. of students): experimental
	55-58	SC16	Class size (no. of students): control
	59-61	SC17	% mortality: experimental
	62-64	SC18	% mortality: control
	65-66	SC19	Experience or background congruence: (1) good (5) poor

	67-68	SC20	Content organizing ability: (1) good (5) poor
	69-70	SC21	Piagetian level: (1) preoperational (2) concrete (3) formal

Card	Column		Variable
2	1-2	SC22	Seriation ability: (1) Stage I (2) Stage II (3) Stage III

TEACHER CHARACTERISTICS

Card	Column		Variable
	3-4	TC01	Age
	5-6	TC02	Experience teaching (avg. no. of yrs.)
	7-8	TC03	Science background (avg. no. of college courses)
	9-11	TC04	Race (% non-white)
	12-13	TC05	Predominant minority: (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
	14-16	TC06	%Predominant minority
	17-19	TC07	Gender (% female)
	20-21	TC08	In-service training in strategy or curriculum: (1) None (2) Some (3) A lot
	22-23	TC09	Federally sponsored (1) Yes (2) No
	24-25	TC10	University sponsored: (1) Yes (2) No
	26-27	TC11	Locally sponsored: (1) Yes (2) No
	28-29	TC12	Pre-service training in strategy or curriculum: (1) None (2) Some (3) A lot
	30-32	TC13	Experience with specific curriculum (wks.)
	33-34	TC14	Educational background: (1) < Bachelors (2) Bachelors (3) Bachelors + 15 (4) Masters (5) Masters + 15 (7) Doctorate
	35-37	TC15	Special training given (% teachers with training specialized for program method)
	38-39	TC16	Acceptance of philosophy: (1) low (2) medium (3) high

CONTEXT CHARACTERISTICS

Card	Column		Variable
	40-41	CC01	Size of school: (1) < 50 (2) 50-199 (3) 200-499 (4) 500-999 (5) 1,000-2,000 (6) > 2,000
	42-43	CC02	Community type: (1) Urban (2) Rural (3) Suburban (4) Mixed
	44-45	CC03	Foreign Milieu: (1) Middle East (2) Canada (3) Isreal (4) U.S. Dep. Schools - Europe

DESIGN CHARACTERISTICS

Card	Column		Variable
	46-47	DC01	Assignment of Ss to Treatments: (1) Random (2) Matched (3) Intact Groups (4) Self-select
	48-49	DC02	Assignment of Teachers to Treatments: (1) Random (2) Non-Random (3) Self-Select (4) Crossed (5) Matched (6) Investigator
	50-51	DC03	Rated Internal Validity (see conventions): (1) Low (2) Medium (3) High
	52-53	DC04	Unit of Analysis: (1) Individual (2) Classroom (3) Grade Level (4) School (5) District
	54-55	DC05	Type of Study: (1) Correlational (2) Quasi-Experimental (Descriptive) (3) Experimental (4) Pre-Experimental (One group pre/post)
	56-57	DC06	Experimental Design: (1) Blocking (10) Factorial (30) Covariance (31) Covariance Blocking (32) Covariance Factorial (33) Covariance Blocking & Factorial

TREATMENT

Duration:

58-59	TD01	Number of weeks
60-62	TD02	Number of sessions
63-65	TD03	Minutes per session

Card	Column	Variable
		Experimental Group
		Characteristics:
		Pre - instructional Strategies:
3	1-2	EX01 Advance Organizers: (1) Used (2) Integrative (3) Expository (4) Subsumption (5) Correlative (6) Comparative (7) Expository (Abstract) (8) Expository (Concrete)
	3-6	EX02 Length (1) ___ ___ ___ Words (2) ___ ___ ___ Minutes
	7-8	EX03 Style: (1) Written (2) Written & Lab (3) Verbal (4) Discussion
	9-10	EX04 Behavioral Objectives: (1) Used
	11-12	EX05 Set Induction: (1) Used
		Inquiry Orientation:
	13-14	EX06 Inductive vs. Deductive: (1) Inductive (Discovery) (2) Deductive (Expository)
	15-16	EX07 Guidance: (1) Structured (2) Free exploration (3) Guided exploration
		Manipulative Level:
	17-18	EX08 Level of Access: (1) Remote demonstration (2) Individual manipulation
	19-20	EX09 Extent of Access: (1) Periodic (2) Frequent
	21-22	EX10 Type of Use: (1) Picture study (2) Object manipulation (3) Both
	23-24	EX11 Levels of Inquiry (see Shulman & Tamir, 1973): (1) None (2) Low (3) Medium (4) High
		Characteristics of Learning Tasks:
	25-26	EX12 Kinetic Structure (see Anderson, 1969): (1) Low structure (2) High structure (3) Intermediate structure
	27-31	EX13 Commonality Coefficient (B_1) (3 digits to right of decimal)
	32-33	EX14 Mathemagenic Behaviors (see Rothkopf, 1970): (1) Used (2) Translation (3) Segmentation (4) Processing
	34-35	EX15 Types of Learning (see Gagne, 1970): (1) Signal (2) Stimulus-Response (3) Chaining (4) Verbal association (5) Multiple discrimination (6) Concept learning (7) Rule learning (8) Problem solving
	36-37	EX16 Levels of Activities (see Bloom, 1956): (1) Knowledge (2) Concept (3) Application (4) Analysis (5) Synthesis (6) Evaluation (7) Application - Evaluation
	38-39	EX17 Conditions of Learning (see Gagne, 19[illegible]7): (1) Motor skills (2) Attitude (3) Verbal information (4) Intellectual skills (5) Cognitive strategies (6) Intellectual skills & Cognitive strategies
	40-41	EX18 Kinds of Activities (1) Recall (2) Distinctions (3) Develop (4) Assess

	42-43	EX19 Learning Structure Condition: (1) Compatible (2) Incompatible
		Scientific Thinking and Reasoning Strategy Orientation:
	44-45	EX20 Cognitive level of emphasis (see Piaget, 1936): (1) Sensory Motor (2) Pre-operational (3) Concrete operational (4) Formal operational
	46-47	EX21 Reasoning strategies: (1) Hypothetico-Deductive (2) Theoretical (3) Combinatorial (4) Probabilistic (5) Proportional (6) Proportional & Combinatorial
	48-49	EX22 Cognitive level of emphasis (see Klausmeier, 1979): (1) Concrete level (2) Identity level (3) Classificatory level (4) Formal level
	50-51	EX23 Process-orientation: (1) Observation (10) Investigating and Manipulating: (11) Controlling variables (12) Predicting (13) Formulating hypotheses (14) Deisgning experiments (15) Experimenting (20) Organizing and Quantifying: (21) Measuring (22) Classifying (23) Using numbers (24) Collecting and organizing data (30) Generalizing: (31) Inferring (32) Interpreting data (33) Explanation (34) Formulating models
		Structure of Content: (see Haggis and Adey, 1979):
	52-53	EX24 Organization of content: (1) Topic (2) Process (3) Concept (4) Environment (5) Historical (6) Psychological (7) Random
	54-55	EX25 Scope of Content: (1) Disciplinary (2) Integrated (3) Multi-Disciplinary (4) Interdisciplinary
	56-57	EX26 Disciplines: L) Chemistry and Physics (2) Biology, Chemistry, and Physics (3) Science and Industrial Arts (4) Physical Geology and Archeology (5) Biology and Art (6) Science and Math
	58-59	EX27 Intensity of Integration: (1) Coordinated (2) Combined (3) Amalgamated
		Question Characteristics:
	60-61	EX28 Level (see Bloom, 1956): (1) Knowledge (2) Concept (3) Application (4) Analysis (5) Synthesis (6) Evaluation (7) Application-Evaluation
	62-63	EX29 Type: (1) Adjunct (2) Relevant (3) Incidental
	64-65	EX30 Degree of Generality: (1) Items (2) Catagories (3) Systematic Patterns
		Instructional Sequencing:
	66-67	EX31 Type: (1) Progressive differentiation (2) Developmental level of cognitive functioning (3) Hierarchical (4) Random (5) Learning cycle (i.e. SCIS)
	68-69	EX32 Sequencing Unit: (1) Single lesson (2) Instructional unit (3) Instructional Term (4) Instructional Program

ard	Column	Variable
		Characteristics of Content:
4	1-2	EX33 Content-orientation (see Klopfer, 1971): (1) General science (10) Biological science: (11) Microbiology (12) Genetics (13) Evolution (14) Botany (15) Zoology (16) Physiology (17) Ecological (24) Biological Names

		(25) Chemistry:(26) Atomic and Molecular Structure (27) Chemical Bonding (28) Mole Concept (29)Chemical reactions (30) Kinetic Theory (31) Energy Relationships and Equilibrium in Chemical Systems (32) Electrochemistry (33) Organic Chemistry (34) Chemistry of Life Processes (35) Nuclear Chemistry
		(40)Physics: (41) Electricity and Magnetism (42) Heat (43) Energy (44) Light (45) Properties and Structure of Matter (46) Sound and Wave Phenomena (47) Mechanic and Motion (48) Heat and Optics
		(55) Earth Science (56) Astronomy (57) Physical Geology (58) Oceanography (59) Meteorology (60) Historical Geology
		(65) Biochemistry
3-4	EX34	Concept orientation (see Fuse, 1975): (1) Cause-effect (2) Change (3) Cycle (4) Energy (5) Matter (6) Interaction (7) Model (8) Organism (9) Population (1) System (11) Theory
5-6	EX35	Affective orientation: (1) Used
7-8	EX36	(see Bloom, 1964): (1) Attending (2) Responding (3) Valuing (4) Organization (5) Value complex
9-10	EX37	Values orientation (see Fuse, 1975): (1) Longing to know (2) Questioning (3) Search for data (4) Demand for verification (5) Logic (6) Consideration of premises (7) Consideration of Solutions
11-12	EX38	Issues and/or Application orientation: (1) Used
	Representation of Content:	
13-14	EX39	Relationships: (1) Used (2) Concept Maps (3) Flow Diagrams: Picture Word (4) Flow Diagram: Block Word
15-16	EX40	Pictorial: (1) Photograph (2) Perspective Diagram (3) Outline Drawing
17-18	EX41	Exemplification: (1) Analogy (2) Metaphor
	Prior Knowledge Assessment:	
19-20	EX42	(1) Used (2) Prerequisite concepts (3) Prerequisite concepts: Mathematics
21-22	EX43	Purpose: (1) Covariance (2) Instructional (3) Independent Variable
	Postinstructional Strategies:	
23-24	EX44	Post Organizer: (1) Used
	Features:	
25-26	EX45	Teacher interaction: (1) Direct (2) Indirect
	Instructional Technique:	
27-28	EX46	Management: (1) Diagnostic testing and prescription (2) Mastery learning approach (3) Competency-based
29-30	EX47	Organization: (1) Individualized instruction (2) Computer managed or assisted instruction (3) Audio-tutorial (4)Programmed

Mode of Communicating Knowledge:

31-32 EX48 (1) Audio-visual (2) Audio (3) Written

33-34 EX49 (1) Lecture (2) Discussion (3) Both

35-36 EX50 (1) Demonstration (2) Laboratory (3) Field Trip (4) Demonstration and Laboratory (5) Laboratory and Field Trip

Evaluation Techniques:

37-38 EX51 Testing Format: (1) Objective (2) Subjective (3) Both

39-40 EX52 Grading: (1) Pass/Fail (2) Letter grade (3) Non-grade (4) Mastery testing

41-42 EX53 Activities: (1) Incidental (2) Adjunct (3) Integrated

43-44 EX54 Text: (1) Text only (2) Text and manipulatives (3) Manipulatives only

Control Group

Characteristics:

Pre - instructional Strategies:

45-46 CT01 Advance Organizers: (1) Used (2) Integrative (3) Expository (4) Subsumption (5) Correlative (6) Comparative (7) Expository (Abstract) (8) Expository (Concrete)

47-50 CT02 Length (1) ___ ___ ___Words (2) ___ ___ ___ Minutes

51-52 CT03 Style: (1) Written (2) Written & Lab (3) Verbal (4) Discussion

53-54 CT04 Behavioral Objectives: (1) Used

55-56 CT05 Set Induction: (1) Used

Inquiry Orientation:

57-58 CT06 Inductive vs. Deductive: (1) Inductive (Discovery) (2) Deductive (Expository)

59-60 CT07 Guidance: (1) Structured (2) Free exploration (3) Guided exploration

Manipulative Level:

61-62 CT08 Level of Access: (1) Remote demonstration (2) Individual manipulation

63-64 CT09 Extent of Access: (1) Periodic (2) Frequent

65-66 CT10 Type of Use: (1) Picture study (2) Object manipulation (3) Both

67-68 CT11 Levels of Inquiry (see Shulman & Tamir, 1973): (1) None (2) Low (3) Medium (4) High

Characteristics of Learning Tasks:

69-70 CT12 Kinetic Structure (see Anderson, 1969): (1) Low structure (2) High structure (3) Intermediate structure

rd

1-5 CT13 Commonality Coefficient (B_1) (3 digits to right of decimal)

6-7 CT14 Mathemagenic Behaviors (see Rothkopf, 1970): (1) Used (2) Translation (3) Segmentation (4) Processing

8-9 CT15 Types of Learning (see Gagne, 1970): (1) Signal (2) Stimulus-Response (3) Chaining (4) Verbal association (5) Multiple discrimination (6) Concept learning (7) Rule learning (8) Problem solving

10-11 CT16 Levels of Activities (see Bloom, 1956): (1) Knowledge (2) Concept (3) Application (4) Analysis (5) Synthesis (6) Evaluation (7) Application - Evaluation

12-13 CT17 Conditions of Learning (see Gagne, 1977): (1) Motor skills (2) Attitude (3) Verbal information (4) Intellectual skills (5) Cognitive strategies (6) Intellectual skills & Cognitive strategies

14-15 CT18 Kinds of Activities (1) Recall (2) Distinctions (3) Develop (4) Assess

16-17	CT19	Learning Structure Condition: (1) Compatible (2) Incompatible
		Scientific Thinking and Reasoning Strategy Orientation:
18-19	CT20	Cognitive level of emphasis (see Piaget, 1936): (1) Sensory Motor (2) Pre-operational (3) Concrete operational (4) Formal operational
20-21	CT21	Reasoning strategies: (1) Hypothetico-Deductive (2) Theoretical (3) Combinatorial (4) Probabilistic (5) Proportional (6) Proportional & Combinatorial
22-23	CT22	Cognitive level of emphasis (see Klausmeier, 1979): (1) Concrete level (2) Identity level (3) Classificatory level (4) Formal level
24-25	CT23	Process-orientation: (1) Observation (10) Investigating and Manipulating: (11) Controlling variables (12) Predicting (13) Formulating hypotheses (14) Deisgning experiments (15) Experimenting (20) Organizing and Quantifying: (21) Measuring (22) Classifying (23) Using numbers (24) Collecting and organizing data (30) Generalizing: (31) Inferring (32) Interpreting data (33) Explanation (34) Formulating models
		Structure of Content: (see Haggis and Adey, 1979):
26-27	CT24	Organization of content: (1) Topic (2) Process (3) Concept (4) Environment (5) Historical (6) Psychological (7) Random
28-29	CT25	Scope of Content: (1) Disciplinary (2) Integrated (3) Multi-Disciplinary (4) Interdisciplinary
30-31	CT26	Disciplines: L) Chemistry and Physics (2) Biology, Chemistry, and Physics (3) Science and Industrial Arts (4) Physical Geology and Archeology (5) Biology and Art (6) Science and Math
32-33	CT27	Intensity of Integration: (1) Coordinated (2) Combined (3) Amalgamated
		Question Characteristics:
34-35	CT28	Level (see Bloom, 1956): (1) Knowledge (2) Concept (3) Application (4) Analysis (5) Synthesis (6) Evaluation (7) Application-Evaluation
36-37	CT29	Type: (1) Adjunct (2) Relevant (3) Incidental
38-39	CT30	Degree of Generality: (1) Items (2) Catagories (3) Systematic Patterns
		Instructional Sequencing:
40-41	CT31	Type: (1) Progressive differentiation (2) Developmental level of cognitive functioning (3) Hierarchical (4) Random (5) Learning cycle (i.e. SCIS)
42-43	CT32	Sequencing Unit: (1) Single lesson (2) Instructional unit (3) Instructional Term (4) Instructional Program
		Characteristics of Content:
44-45	CT33	Content-orientation (see Klopfer, 1971): (1) General science (10) Biological science: (11) Microbiology (12) Genetics (13) Evolution (14) Botany (15) Zoology (16) Physiology (17) Ecological (24) Biological Names

(25) Chemistry: (26) Atomic and Molecular Structure (27) Chemical Bonding (28) Mole Concept (29) Chemical reactions (30) Kinetic Theory (31) Energy Relationships and Equilibrium in Chemical Systems (32) Electrochemistry (33) Organic Chemistry (34) Chemistry of Life Processes (35) Nuclear Chemistry

(40) Physics: (41) Electricity and Magnetism (42) Heat (43) Energy (44) Light (45) Properties and Structure of Matter (46) Sound and Wave Phenomena (47) Mechanic and Motion (48) Heat and Optics

(55) Earth Science (56) Astronomy (57) Physical Geology (58) Oceanography (59) Meteorology (60) Historical Geology

(65) Biochemistry

46-47	CT34	Concept orientation (see Fuse, 1975): (1) Cause-effect (2) Change (3) Cycle (4) Energy (5) Matter (6) Interaction (7) Model (8) Organism (9) Population (1) System (11) Theory
48-49	CT35	Affective orientation: (1) Used
50-51	CT36	(see Bloom, 1964): (1) Attending (2) Responding (3) Valuing (4) Organization (5) Value complex
52-53	CT37	Values orientation (see Fuse, 1975): (1) Longing to know (2) Questioning (3) Search for data (4) Demand for verification (5) Logic (6) Consideration of premises (7) Consideration of Solutions
54-55	CT38	Issues and/or Application orientation: (1) Used
	Representation of Content:	
56-57	CT39	Relationships: (1) Used (2) Concept Maps (3) Flow Diagrams: Picture Word (4) Flow Diagram: Block Word
58-59	CT40	Pictorial: (1) Photograph (2) Perspective Diagram (3) Outline Drawing
60-61	CT41	Exemplification: (1) Analogy (2) Metaphor
	Prior Knowledge Assessment:	
62-63	CT42	(1) Used (2) Prerequisite concepts (3) Prerequisite concepts: Mathematics
64-65	CT43	Purpose: (1) Covariance (2) Instructional (3) Independent Variable
	Postinstructional Strategies:	
66-67	CT44	Post Organizer: (1) Used
	Features:	
68-69	CT45	Teacher interaction: (1) Direct (2) Indirect
	Instructional Technique:	
70-71	CT46	Management: (1) Diagnostic testing and prescription (2) Mastery learning approach (3) Competency-based
Card		
1-2	CT47	Organization: (1) Individualized instruction (2) Computer managed or assisted instruction (3) Audio-tutorial (4) Programmed

Mode of Communicating Knowledge:
3-4 CT48 (1) Audio-visual (2) Audio (3) Written
5-6 CT49 (1) Lecture (2) Discussion (3) Both
7-8 CT50 (1) Demonstration (2) Laboratory (3) Field Trip (4) Demonstration and Laboratory (5) Laboratory and Field Trip

Evaluation Techniques:
9-10 CT51 Testing Format: (1) Objective (2) Subjective (3) Both
11-12 CT52 Grading: (1) Pass/fail (2) Letter grade (3) Non-grade (4) Mastery testing

13-14 CT53 Activities: (1) Incidental (2) Adjunct (3) Integrated
15-16 CT54 Text: (1) Text only (2) Text and manipulatives (3) Manipulatives only

OUTCOME CHARACTERISTICS

Intent of Assessment:
17-18 OC01 Aquisition (Novelty of Content): (1) Identical (2) Similar
19-20 OC02 Transfer (Novelty of Context): (1) Related (2) New (3) Vertical (4) Lateral
21-22 OC03 Retention (wks.)

Domain orientation:
23-24 OC04: (1) Cognitive
(2) Knowledge and/or comprehension (3) Application
(4) Cognitive mixed - general achievement (5) Process skills
(6) Critical thinking and problem solving (7) Creativity
(8) Decision-making (9) Logical thinking - Piagetian
(10) Spatial relationship (11) Formal understanding

(20)Affective
(21)Affective-subject
(22)Affective-science
(23)Affective-procedure/method (24) Values (25) Interest
(26)Nature of scientific knowledge (27) Affective- milieu

(40) Psychomotor/Behavioral (41) Methods of science
(42) On-task behavior/learner activity (43) Task performance

25-26 OC05 Congruence of Measurement (Experimental - T1): (1)Yes (2)No
27-28 OC06 Congruence of Measurement (Control - T2): (1)Yes (2) No
29-30 OC07 Type of Measurement: (1) National published (2) Ad hoc unpublished (3) Teacher made classroom evaluation instrument
31-32 OC08 Method of Measurement: (1) Multiple choice (2) Questionnaire (3) Observation (4) Structured Interview (5) Open-ended (6) Ordinal Scale (7) Multiple choice and essay (8) Multiple choice and short answer
33-34 OC09 Content-orientation: (1) Reading (10) Mathematics (20) Social science (30) Science (40) Biological sciences (41) Microbiology (42) Genetics (43) Evolution (44) Botany (46) Physiology (47) Ecological (49) Biological Terms (50) Chemistry (51) Atomic and Molecular Structure (52) Chemical Bonding (53) Mole Concept (54) Chemical reactions (55) Kinetic Theory (56) Energy relationships and equilibrium in chemical systems (59) Nuclear Chemistry (60) Physics (61) Electricity and Magnetism (62) Heat (63) Energy (64) Light (65) Properties

		and structure of Matter (66) Sound and wave phenomena (67) Mechanics and Motion (68) Heat and Optics (70) Earth science (72) Physical geology (80) Biochemistry
35-36	OC10	Reactivity (i.e. fakeability - see conventions): (1) low (2) Medium (3) high
37-41	OC11	Reliability (2 digits to right of decimal)

EFFECT SIZE CALCULATION

42-43	ES01	Source of effect size data: (10) Directly from reported data or raw date (means and variances) (11) Unadjusted posttest (12) Pre-post differences (13) Covariance adjusted (20) Reported with direct estimates (21) T-value (22) ANOVA and F-value (23) Multiple comparison q (24) ANOCOVA (30) Correlational (40) Sample size and P-level (50) Backwards from variance of means with randomly assigned groups (60) Nonparametric (61) Directly from frequencies reported on ordinal scale)Probit, Chi-square) (62) Frequencies reported on nominal scale (63) Mann-Whitney U (70) Estimated from variance of gain scores (correlation guessing) (80) Guessed from independent sources (test manuals, other students using same test, conventional wisdom)
44-45	ES02	Reported significance: (1) $p < .005$ (2) $.005 < p < .01$ (3) $.01 < p < .05$ (4) $.05 < p < .10$ (5) $p > .10$
46-47	ES03	Dependent variable units: (1) grade-equivalent units (2) percentile rank (3) Other
48-49	ES04	Mean difference in grade equivalent units
50-54	ES05	Study effect size (2 digits to right of decimal)

File #5 - Teacher Education

N of Cases: 177 Cards/Case: 6

Other Information: Decimals included in raw data where appropriate.

Card	Column	Variable
1	1-4	Study Code (4 digits, corresponds to Master List)
	5-8	Start of Study
	9-12	End of Study
	13-16	Publication Date
	17	Form of Publication (1) Journal (2) Book (3) MA Thesis (4) Dissertation (5) Unpublished (6) Other
		DESIGN CHARACTERISTICS
	18	Type of Study (1) Correlational (2) Quasi-experimental (3) Experimental (4) Other
	19	Outcomes measure on (1) Teacher/teacher trainees only (3) Students only (3) Both
	20	Assignment of teachers to treatments (1) Random (2) Matched (3) Self-selected (4) Intact groups (5) Representative sample (6) Other
	21-24	Total number of teachers assigned
	25=28	Total number of teachers analyzed
	29-31	% Mortality
	32	Teacher unit of analysis (1) Individual (2) Classroom (3) School (4) Other
	33	Teacher unit of analysis correct? (1) Yes (2) No
	34	Assignment of students to treatments (1) Random (2) Matched (3) Self-selected (4) Intact groups (5) Representative sample (6) Other
	35-38	Total number of students assigned
	39-42	Total number of students analyzed
	43	Student unit of analysis (1) Individual (2) Classroom (3) School (4) Other
	44	Student unit of analysis correct? (1) Yes (2) No
	45	Rated internal validity (1) low (2) medium (3) high
	46	Design Rating (1) low (2) medium (3) high
	47	Is data present to determine experimental and control variances? (1) Yes (2) No

ard	Column	Variable
		TEACHER/TEACHER TRAINEE CHARACTERISTICS
2	5	(1) Characteristic specific for members of the individual treatment group (2) Characteristic generalized across groups (3) Characteristic as subgroups within this treatment (4) Other

6-9	Number of individuals in the sample
10-12	Age Average (years)
13-15	Age Range (years
16-18	Gender (% Female)
19	College education background (1) Elementary education major (2) Secondary education major (7-12) (3) Education major across levels (4) Major outside education (5) Other
20-21	Subject major (1) biology (2) earth science (3) chemistry (4) physics (5) science comprehensive (6) other science program (7) mix of two sciences (8) mix of more thatn two sciences*(9) mix of science and math (10) general mix (11) other than science or math *Use 8 if mix of science is not specified (i.e., science in general).
22	Subject minor (same code as above)
23	Current level of college enrollment (1) Freshman (2) Sophomore (3) Junior (4) Senior (5) Graduate (6) Mixed junior and senior (7) Other mix (8) Other
24	Degree Status: (1) less than Bachelors (2) Bachelors (3) Bachelors + 15 (4) Masters (5) Masters + 15 (6) Masters + 30 (7) Doctorate
25-26	Experience teaching (0) no teaching (1) practice teaching only (2) one year (3) two years (4) three years (5) four years (6) five years (7) six years (8) seven years (9) eight years (10) nine years (11) ten years (12) eleven years (13) twelve years (14) thirteen years (15) fourteen years and beyond
27-28	Experience teaching science (same code as above)
29-31	Experience with specific curriculum/method (average # of years)
35	Dogmatism (1) low (2) medium (3) high
36-37	Number of science courses
38-40	Semester hours of science courses
41	Grade in science courses (1) low (D-C) (2) medium (C-B) (3) high (B-A)
42-43	Number of science methods courses
44-45	Semester hours of science methods courses
46	Grade in methods courses (1) low (2) medium (3) high
47	Undergraduate grade (1) low (2) medium (3) high
48	Teacher education courses grade (1) low (2) medium (3) high
49	Grade in student teaching (1) low (2) medium (3) high

STUDENT CHARACTERISTICS*

*Used only in studies of effects of teachers' training on pupil outcomes.

Card	Column	Variable
3	1-4	Study Code
	5	(1) Characteristics specific for members of this individual treatment group (2) characteristics generalized across groups
	6-9	Number of individuals in the sample
	10-12	Age average
	13-16	Age Range
	17-19	Gender (% Female)
	20-23	Grade level (average in more than one) (one digit to right of decimal)
	24-25	N grades
	26-27	Ranges

28-30	Average IQ (give number)
31	IQ Homogeniety (1) Homogeneous (2) Heterogeneous
32	Source of IQ (1) Stated (2) Inferred
33-34	Range of IQ (number of points difference)
35-37	Race (% non-white)
38	Predominant minority (1) Mixican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
39	Average SES (1) low (2) medium (3) high
40	SES Homogeneity (1) Homogeneous (2) Heterogeneous

Card	Column	Variable
4	1-4	Study Code
	5-8	Treatment Code
	9-12	N of Treatments
	13	Sponsor (1) NSF (2) other federal (3) state (4) university based (4) other
	14	Time of treatment (1) pre-service (2) inservice (3) other
	15	Site of treatment (1) field based, site of employment
	16	Extent of treatment (1) multi-grade or level e.g. course, workshop (3) training technique (4) other
	17	Treatment geared to grade level (1) pre-school (2) elementary (3) middle school (4) junior high school (5) high school (6) general (7) other (8) secondary
	18-19	Context 1 1:
	20-21	Context 1 2:

(1) competency based program
(2) field based program
(3) self directed study program
(4) computer assisted instruction program
(5) ongoing institute
(6) summer institute
(7) workshop
(8) methods course
(9) university science course
(10) university science course design for teachers
(11) minicourse
(12) practice teaching
(13) education course (not methods)
(14) biology classroom
(15) chemistry classroom
(16) physical science classroom
(17) physics classroom
(18) earth science classroom
(19) general science classroom
(20) other science classrooms
(21) elementary classrooms
(22) microteaching peers
(23) microteaching students
(24) behavior coding training or exposure
(25) other

22-23	Treatment Type 101:
24-25	Treatment Type 102:

Organization:
(1) competency based program
(2) field based program
(3) ongoing institute
(4) summer institute
(5) workshop
(6) methods course
(7) science course
(8) science course designed for teachers
(9) minicourse
(10) units of study
(11)

- 26-27 Treatment Type 103:
  - Strategy:
    - (12) general
    - (13) traditional
    - (14) inquiry
    - (15) discovery
    - (16)
- 28-29 Treatment Type 104:
  - Mode:
    - (17) verbal
    - (18) mixed
    - (19) concrete
    - (20)
- 30-31 Treatment Type 105:
  - Interaction:
    - (21) direct
    - (22) mixed
    - (23) indirect
    - (24)
- 32-33 Treatment Type 106:
  - Source of structure:
    - (25) student self direct
    - (26) student interacting with materials and/or teacher
    - (27) teacher
    - (28) criterion referenced
- 34-35 Treatment Type 107:
  - Locus of Control:
    - (29) student self-direct
    - (30) student and teacher working together
    - (31) teacher directed
    - (32) Mix, part student, part teacher

- 36-37 Treatment Type 108:
- 38-39 Treatment Type 109:
  - Technique:
    - (33) IA feedback
    - (34) Instructional strategy feedback
    - (35) wait-time analysis
    - (36) questioning analysis
    - (37) micro-teaching peers
    - (38) micro-teaching students
    - (39) modeling strategy
    - (40) behavior coding training (e.g. IA) or strategy analysis
    - (56) interview training
    - (57) question construction
    - (58) persuasive communication

- 40-41
  - Technology:
    - (41) Audio technology
    - (42) video technology
    - (43) computer technology
    - (44) programmed material (a-t)
    - (45) print material

42-43 Treatment Emphasis Content 101:
44-45 Treatment Emphasis Content 102:
46-47 Treatment Emphasis Content 103:
48-49 Treatment Emphasis Content 104:

Knowledge and Intellectual processes:
(1) science content
(2) sciences processes
(3) knowledge of teaching strategies and classification and techniques
(4) learning theory
(5) learning styles
(6) learning skills
(7) lab skills
(8) methods of science and the scientific enterprise
(9) critical thinking
(10) creativity
(11) decision making
(12) logical thinking
(13) spatial reasoning
(14) problem solving
(15) behavioral objectives
(16) teat construction
(17) planning (organizational skill)
(18) verbal behavior, general
(19) inquiry strategy
(20) concrete manipulative strategy
(21) indirect verbal behavior
(22) interpersonal behaviors (response behavior, accepting verbal, interaction, rapport) relationships
(23) wait-time
(24) questioning level
(25) classroom management
(26) discovery strategy (student center, open)
(27) attitude (general)
(28) attitude toward science
(29) attitude toward science teaching
(30) attitude toward treatment
(31) dogmatism (toward open)
(32) self-concept
(33) values
(34) philosophy of teaching (perceived role expectation)
(35) characteristics (toward student centered)
(36) implementation
(37)
(39) ESS
(40) SCIS
(41) SAPA
(42) History of science
(43) DISCUS
(44) AAAS
(45) BSCS

(50) Group process skills
(51) questions- process directed
(52) reactions to classroom situations
(53) leadership or change - agent strategies
(54) attitude toward treatment emphasis
(55) knowledge of question categories

	50-52	Blank
	53-55	Treatment duration (days)
	56-59	Treatment duration contact (hours)
	60	Fidelity to treatment (1) yes (2) no
	61	Treatment contact type (1) continuous (2) intermittent (3) other
	65-66	

Card	Column	Variable
5	1-4	Study Code
	5-8	Outcome Characteristics Title of Measure Used:____________________
	9	Measure on (1) teachers (2) students (3) on students about teachers
	10-13	N of outcome
	14-15	Criteria: Use same categories as treatments emphasis
	16	Measured type: (1) Published - national standardized (2) ad-hoc for that study (3) departmental or local standard (4) classroom developed (5) other
	17	Measurement intent (1) right-wrong (2) survey, or attitude
	18	Measurement method (1) multiple choice (2) semantic differential (3) Likert (4) questionnaire (5) observation (6) interview (7) Q-sort (8) other
	19-20	Test reliability (2 digits to right of decimal)
	21	Reliability measure (1) test-retest (2) parallel forms (3) split-half (4) internal consistency
	22	Validity established (1) yes (2) no
	23	Time of measurement (1) before treatment (2) after treatment (3) pre-post (4) delayed (5) other
	24	If pre-post (1) test, retest identical (2) test, retest-parallel (3) other
	25	Reactivity (1) high (2) medium (3) low
	26	If pre-post, is a ceiling effect apparent? (1) Yes (2) No
	27-28	Inter observer reliability, inter-scorer (2 digits to right of decimal)
	29	Formula for test reliability calculation (1) KR-20 (2) Spearman Brown (3) Cronback Al (4) Hoyt's (5) ANOVA (6) Pearson product (7) KR-21 (8)
	30	Formula for inter-observer reliability (1) Scott's (2) Ebel's intraclass (3) ANOVA (4) Pearson's r (5) Hoyt
	65-66	

EFFECT SIZE

Card	Column	Variable
6	1-4	Study Code
	5-8	Treatment Comparison Code
	9-12	Outcome Code

13	Calculation of effect size (1) directly from reported data or raw data (means and variances) (2) reported with direct estimates (ANOVA, t, F) (3) directly from frequencies reported on ordinal scale (Probit, X^2) (4) backwards from variance of means with randomly assigned groups (5) nonparametrics (other than #3) (6) guessed from independent sources (test manuals, other students using the same test, conventional wisdom) (7) estimated from variance of gain scores (correlation estimating) (8) probability levels (9) pre-test data used as a control group
14-15	Number of instruments pooled to calculate effect size
22	Source of means (1) unadjusted post-test (2) covariance (3) residual gains (4) pre-post differences (5) other
23	Significance (as reported) (1) p .005 (2) p .01 (3) p .05 (4) p .10 (5) p .10
24-28	Effect Size (2 digits to right of decimal, decimal included in raw data)
65-66	

File #6 - Teacher Characteristics

N of Cases: 179 Cards/Case: 7

Other Information: Decimal points are not included in raw data. Users must allow for them in their own input formal instructions. In this file, several correlations (effects) may be coded for a single case; however, they must pertain to the same outcome variable. Thus, correlations with different outcomes from the same study are considered as separate cases.

Card	Column	Variable
1	1-2	Reader Code
	3-6	Study Code
	7-10	Criterion Code (e.g., 0102 indicates first of two criteria from same study)
	11-12	Date of Study Report (last 2 digits of year)
	13	Form of Study (1) Journal (2) Book (3) Masters Thesis (4) Dissertation (5) Unpublished
		STUDENT CHARACTERISTICS
	14-18	Sample size (total N)
	19-21	Average IQ
	22	IQ Homogeneity (1) Homogeneous (2) Heterogeneous
	23	Source of IQ (1) Stated (2) Inferred
	24	Range of IQ (Number of points difference)
	26	Grade level (1) primary K-3 (2) Intermediate 4-6 (3) Jr. High 7-9 (4) Sr. High 10-12 (5) 1-6 (6) 7-12 (7) 9-12 (8) 1-12 (9) > 12
	27	Elementary science program (1) SCIS (2) SAPA (3) ESS (4) Textbook (5) Other
	28	H.S. science program (0) mixture science and non-science (1) general science (2) life science (3) physical science (4) biology (5) earth science (6) chemistry (7) physics (8) biology, chemistry, physics.
	29-30	Number of high school science courses taken
	31-32	Experience in program (# of months)
	33-35	Gender (% female)
	36	Predominant minority (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other
	37	Average SES (1) low (2) medium (3) high

38	Special Grouping (1) not grouped (2) low track (3) medium (4) high
39	Type of school (1) open (2) traditional Location________________________________
40	Type of community (1) urban (2) inner city (3) urban fringe (4) rural
41	Size of community (1) < 10,000 (2) 10,000 < 50,000 (3) 50,000 < 100,000 (4) 100,000 < 500,000 (5) 500,000 < 1 million (6) > 1 million
42-44	Average Class Size

TEACHER CHARACTERISTICS

45-49	Sample size (total N of teachers)
50-51	Mean age to nearest year
52-53	# of education courses taken (3 cr./course)
54-55	# of science courses taken (4 cr./ course)
56-57	# of biology courses taken
58-59	# of chemistry courses taken
60-61	# of physics courses taken
62-63	Undergraduate GPA (one digit to right of decimal)
64-65	Grade in student teaching experience (one digit to right of decimal)
66-67	Experience teaching biology (average # of years)
68-69	Experience teaching chemistry (average # of years)
70-71	Experience teaching physics (average # of years)
72-73	Experience teaching (average # of years)
74-75	Experience teaching science (average # of years)
76	Teaching specialization (0) general elementary (1) elementary science (2) life science (4) physical science (5) biology (6) earth science (7) chemistry (8) physics (9) other
77	Educational background (1) Bachelors (2) 75% Bachelors 25% Masters (3) 50% Bachelors 50% Masters (4) Masters (5) 75% Masters 25% PhD (6) 50% Masters 50% PhD (7) Doctorate (8) 25% Bachelors 75% Masters (9) 25% Masters 75% PhD

78 Subject Matter Knowledge (by standardized tests) (1) low (2) medium (3) high

79 List test: (1) NTE (2)________

80 "1" indicating 1st card of case

Card	Column	Variable	
2	1-3	Academic Institute (% teachers with training)	
	4-6	Gender (% female)	
	7-9	Race (%non-white)	
	10	Predominant Minority (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other	
	11-13	% Predominant Minority	
	14	Average SES (1) low (2) medium (3) high	
	15	Exhibitionism (1) low (2) medium (3) high	
	16	Autonomy (1) low (2) medium (3) high	
	17	Hererosexuality (1) low (2) medium (3) high	
	18	Enthusiasm (1) low (2) medium (3) high	
	19	Self Concept (1) low (2) medium (3) high	
	20	Self-actualization	
	21	Vanity	
	22	Reflective	(1) low (2) medium (3) high
	23	Physical self	
	24	Personal self	
		Intellectual Independence	
	25	Achievement	
	26	Dominance	
	27	Self-sufficient	(1) low (2) medium (3) high
	28	Adventurous	
	29	Confident	
	30	Receptivity (1) low (2) medium (3) high	
	31	Deference	
	32	Change	
	33	Objectivity	(1) low (2) medium (3) high
	34	Adaptability	
	35	Realistic	
		Friendliness	
	36	Nurturance	
	37	Affiliation	(1) low (2) medium (3) high
	38	Outgoing	
	39	Scholastic Motivation (1) low (2) medium (3) high	
	40	Order	
	41	Endurance	(1) low (2) medium (3) high
	42	Conscientious	
	43	Planfulness	

44	Intellect (1) low (2) medium (3) high	
45	Intelligence	(1) low (2) medium (3) high
46	Analytic	
47	Creative	
48	Imaginative	
	Social Behavior	
49	Motility (energy)	(1) low (2) medium (3) high
50	Stability	
51	Restraint	
52	Anxiety	
	Power Relationships	
53	Aggression	(1) low (2) medium (3) high
54	Abasement	
55	Leadership	
56	Ego Achievement	
57	Forthright	
58	Conservative	
	Values	
59	Aesthetic	(1) low (2) medium (3) high
60	Social	
61	Theoretical	
62	Technological	
	Attitudes	
63	Teaching	(1) low (2) medium (3) high
64	Science	
65	Teaching Science	
66	Specific Subject	

TEACHER BEHAVIOR

67 Laboratory (1) used
68 Professional judgment (1) low (2) medium (3) high
69 Professional Judgment by (1) peers (2) supervisors (3) administrators (4) pupils (5) parents (6) student teachers (7) others

CRITERION CHARACTERISTICS

70 Content (0) combination of sciences (1) elementary science (2) general science (3) life science (4) physical science (5) biology (6) earth science (7) chemistry (8) physics (9) other than science

71-72 Type of Criterion (01) cognitive low (recall, comprehension) (02)cognitive high (application (03)cognitive mixture (general achievement) (04) cognitive preference (05) critical thinking (06) spatial reasoning (07) logical thinking (08) creativity (09) decision making (10) problem solving (11) curiosity (12) response behavior (13) process skills (14) methods of science (15) self-concept (16) affective science (17) affective course (18) affective method (19) social values (20) technological values (21) theoretical values (22) psychomotor (23) other

	73	Data (1) nominal (2) ordinal (3) ratio
	74	# Replications (1) one time (2) posttest (3) post-pre (4) weighted (5) repeated measurement
	75	Method of measurement: (1) published (national, broad, gauged...) (2) ad hoc or criterion referenced (3) classroom evaluation (4) observation (5) structured interview of assessment (6)records
	76	Reactivity (1) low (cognitive measures, one administration or long lag, not alterable) (2) medium (3) high (affective, transparent, alterable)
	77-78	Criterion for teacher behavior (01) teaching effectiveness, efficiency (02) interrelationship between students and teacher (sharing concern, understanding...) (03) similarity of cognitive patterns - (student similarity to teacher) democratic practices (04) teacher orient.(lecture, info. giving, teacher talk, directedness)(05) teacher-student orient.(info.seeking, discussion) (06)student orient.(inquiry, stud.talk, process orientation) Forms of expression: (07) verbal (08) non-verbal (09) congruent (10) contradictory (11) questioning behavior (12) low-level factual, rhetorical (13) flexible-clarifying (14) high-complex, associative, critical thinking (15) wait-time (16) discipline - classroom management (17) use of objectives, directed motivation (18) teacher aura (responsible, interesting...) (19) type of curriculum (text, inquiry...) (20)use of methods, materials (labs...) (21) content development (22) method of teaching (traditional, team...) (23) attigude toward other teaching staff (24) achievement tests of teaching behaviors, science processes (25) attitudes, expectations of specific curriculum (26) other
	79	Method of measurement: (0) Test (1) self report (2) students (3) supervisor's ratings (4) consultant's ratings (5) peers' ratings (6) observation (7) records (8) self reprot and staff ratings (9) structured interview
	80	"2" indicating second card of case

Card	Column	Variable
3	1-4	Mean of criterion (on total N) (one digit to right of decimal)
	5-8	Variance of criterion (on total N) (one digit to right of decimal)
	9-11	Reliability of criterion (two digits to right of decimal)
	12	Type of reliability (1) test-retest (2) equivalence (3) split-half (4) inter-rater (5) homogeneity

STUDY CHARACTERISTICS

	13	Metric of data (1) Pearson correlation (2) biserial correlation (3) point biserial correlation (4) partial correlation Reported statistic:
	14	Source of correlation data: (1) directly from reported data or raw date (means and variances) (2) reported with direct estimates (ANOVA, t,F) (3) directly from frequencies reported on ordinal scale (probit,x^2) (4) non-parametrics (other than #3) (5) guessed from independent sources (test manuals, other students using same test, conventional wisdom)

(6) p-values
(7) others
(8) combination

15 Reported significance: (1) $p \leq .005$ (2) $.005 < p \leq .01$ (3) $.01 < p \leq .05$ (4) $.05 < p \leq .10$ (5) $p < .10$ (6) $.01 < p \leq .10$ (7) $.005 \leq p \leq .05$ (8) $.005 \leq p \leq .10$

16 Unit of analysis (1) individual (2) class (3) teacher (4) grade level (5) school (6) district (7) state (8) extra-state region

Predictors:

General Instructions: Fill out one form for each criterion variable for which correlations with predictors or mean differences on predictors are reported. Criterion is defined as score measured in any of the categories listed in "Criterion Characteristics"

Special Instructions: For data in the form of mean differences in score for predictors such as gender - in the space to the left of each predictor provide $\bar{x}$, S.D., and n for each level of the predictor. This can then be converted into an r and coded at the right.

Rated reliability (1) $r < \underline{.70}$ (2) $\underline{.70} \leq r \leq \underline{.80}$ (3) $r > \underline{.80}$

Correlation of this predictor with student score. For all correlations there are two digits to the right of the decimal point.

TEACHER CHARACTERISTICS

18-20 Teacher age: correlation
21-23 # Education courses: correlation
24-26 # Science courses: correlation
27-29 # Biology courses: correlation
30-32 # Chemistry courses: correlation
33-35 # Physics courses: correlation
36-38 Academic institute: correlation
39-41 Gender: correlation
42-44 Race: correlation
Exhibitionism:
45 reliability
46-48 correlation
Autonomy:
49 reliability
50-52 correlation
Heterosexuality:
53 reliability
54-56 correlation
Enthusiasm:
57 reliability
58-60 correlation
Self-concept:
61 reliability
62-64 correlation

		Self-actualization:
	65	reliability
	66-68	correlation
		Reflective:
	69	reliability
	70-72	correlation
		Physical self:
	73	reliability
	74-76	correlation
	80	"3" indicating third card of case

Card	Column	Variable
		Moral and ethical self:
4	1	reliability
	2-4	correlation
		Personal self:
	5	reliability
	6-8	correlation
		Family self:
	9	reliability
	10-12	correlation
		Social self:
	13	reliability
	14-16	correlation
		Intellectual independence:
	17	reliability
	18-20	correlation
		Achievement:
	21	reliability
	22-24	correlation
		Dominance:
	25	reliability
	26-28	correlation
		Self-sufficient:
	29	reliability
	30-32	correlation
		Adventurous:
	33	reliability
	34-36	correlation
		Confident:
	37	reliability
	38-40	correlation
		Receptivity:
	41	reliability
	42-44	correlation
		Deference:
	45	reliability
	46-48	correlation
		Change:
	49	reliability
	50-52	correlation

	Objectivity:
53	reliability
54-56	correlation
	Adapatability:
57	reliability
58-60	correlation
	Realistic:
61	reliability
62-64	correlation
	Friendliness:
65	reliability
66-68	correlation
	Nurturance:
69	reliability
70-72	correlation
	Succorance:
73	reliability
74-76	correlation
80	"4" indicating fourth card of case

Card	Column	Variable
5		Affiliation:
	1	reliability
	2-4	correlation
		Outgoing:
	5	reliability
	6-8	correlation
		Order:
	9	reliability
	10-12	correlation
		Endurance:
	13	reliability
	14-16	correlation
		Conscientious:
	17	reliability
	18-20	correlation
		Planfulness:
	21	reliability
	22-24	correlation
		Intellect:
	25	reliability
	26-28	correlation
		Intellectually oriented:
	29	reliability
	30-32	correlation
		Intelligence:
	33	reliability
	34-36	correlation
		Analytic ability:
	37	reliability
	38-40	correlation
		Creative ability:
	41	reliability
	42-44	correlation

	Imaginative:
45	reliability
46-48	correlation
	Motility:
49	reliability
50-52	correlation
	Stability:
53	reliability
54-56	correlation
	Restraint:
57	reliability
58-60	correlation
	Anxiety:
61	reliability
62-64	correlation
	Aggression:
65	reliability
66-68	correlation
	Abasement:
69	reliability
70-72	correlation
	Leadership:
73	reliability
74-76	correlation
80	"5" indicating fifth card of case

Card	Column	Variable
		Ego achievement:
	1	reliability
	2-4	correlation
		Dogmatic:
	5	reliability
	6-8	correlation
		Forthright:
	9	reliability
	10-12	correlation
		Conservative:
	13	reliability
	14-16	correlation
		Values:
		Aesthetic:
	17	reliability
	18-20	correlation
		Social:
	21	reliability
	22-24	correlation
		Religious:
	25	reliability
	26-28	correlation
		Theoretical:
	29	reliability
	30-32	correlation
		Technological:
	33	reliability
	34-36	correlation

	Economic:
37	reliability
38-40	correlation
	Political:
41	reliability
42-44	correlation
	Attitudes:
	Teaching:
45	reliability
46-48	correlation
	Science:
49	reliability
50-52	correlation
	Teaching science:
53	reliability
54-56	correlation
	Specific subject:
57	reliability
58-60	correlation
61-63	Undergraduate GPA: correlation
64-66	Student teaching grade: correlation
67-69	Experience teaching biology: correlation
70-72	Experience teaching physics: correlation
73-75	Experience teaching: correlation
76-78	Experience teaching science: correlation
80	"6" indicating sixth card of case

Card	Column	Variable
	1-3	Teaching specialization: correlation
	4-6	Educational background: correlation
		Subject matter knowledge:
	7	reliability
	8-10	correlation
		Cognitive preference:
	11	reliability
	12-14	correlation
		Masculinity
	15	reliability
	16-18	correlation
	19-21	Use of curricula: correlation
		Cognitive pattern similarity:
	22	reliability
	23-25	correlation
		Cognitive level similarity:
	26	reliability
	27-29	correlation
	30	Statistical manipulation: (1) high (2) medium (3) low
	80	"7" indicating seventh card of case

File #7 - Student Characteristics

N of Cases: 308 Cards/Case: 7

Other Information: Decimal points are not included in raw data. Users must allow for them in their own input format instructions. In this file, several effects (or correlations) may be coded for a single case; however, they must pertain to the same outcome variable. Thus, effects involving different outcomes from the same study are reported as effects for different cases. Many cards in this file are completely blank.

BACKGROUND AND CODING INFORMATION

Card	Column	Variable
1	1-2	Reader Code
	3-6	Study Code
	7-10	Criterion Code (e.g., "0102" means that this is the first of two criteria coded from study)
	11-12	Date of Study Report (last two digits of year)
	13	Form of Study (1) Journal (2) Book (3) Master's Thesis (4) Dissertation (5) Unpublished

STUDENT CHARACTERISTICS

Card	Column	Variable
	14-18	Sample Size (Total n if mean difference is metric)
	19-21	Average IQ
	22	IQ homogeneity (1) homogeneous (2) heterogeneous
	23	Source of IQ (1) stated (2) inferred
	24-25	Range of IQ (number of points difference)
	26-27	Mean age to nearest year
	28-29	Grade level (average if more than one)
	30-32	Gender (% Female)
	33	Handicapped (1) visually impaired (2) hearing impaired (3) learning disability (4) emotionally disturbed (5) multiple handicaps (6) EMR (7) other (8) combination or not specifically identified
	34-36	Race (% non-white)
	37	Predominant Minority (1) Mexican (2) Non-Mexican Hispanic (3) Oriental (4) American Indian (5) Black (6) Other

	Minority Percentages
38-40	Mexican
41-43	Non-Mexican Hispanic
44-46	Oriental
47-49	American Indian
50-52	Black
53-55	Other
56	Average SES (1) low (2) medium (3) high
57	SES Homegeneity (1) homogeneous (2) heterogenous
58-60	Average class size
61	Special Grouping (1) not grouped (2) low track (3) medium (4) high (5) mixed
62	Type of school (1) open (2) traditional (3) mixed
63	Type of community (1) urban (2) inner city (3) suburban (4) rural (5) looked at more than one, mixed
64	Science program (1) SCIS (2) SAPA (3) ESS (4) Textbook________________ (5) Activity-centered (6) Mixed (Exp. + Control) (7) Other (8) NSF-sponsored secondary curriculum
65	Number of years in elementary science program
	High School Science Background (courses taken by students)
66	General Science (1) yes (2) no
67	Life Science (1) yes (2) no
68	Physical Science (1) yes (2) no
69	Biology (1) yes (2) no
70	Earth Science (1) yes (2) no
71	Chemistry (1) yes (2) no
72	Physics (1) yes (2) no
73	Number of secondary science courses taken (blank if unknown)
74-75	Experience in program (# of months in treatment program)

STUDY CHARACTERISTICS

76-77	% Mortality
78-79	Source of correlation data (1) Directly from reported data or raw data (means & variances) (2) Reported with direct estimates (ANOVA, t, F) (3) Directly from frequencies reported on ordinal scale (Probit, x^2) (4) Backwards from variance of means with randomly assigned groups (v, etc.) (5) Nonparametrics (other than #3) (6) Guessed from independent sources (test manuals, other studies using same test, conventional wisdom) (7) Estimated from variance of gain scores (correlation guessing) (8) p values - (find t value of p and work backward) (9) Reported with indirect estimates (ANCOVA)

		(10) Pearson correlation (11) Biserial correlation (12) Point biserial (13) Spearman's RHO (14) Calculated based on gains (15) Other (16) More than one (17) From pooled Δ's to t's and worked backwards
	80	Unit of analysis (1) individual (2) grade level (3) school (4) district (5) state (6) extra-state regions

CODING INFORMATION

Card	Column	Variable
2	1	Card Number (always "2")
	2-5	Study code
	6-9	Criterion code

STUDY CHARACTERISTICS

Card	Column	Variable
	10	Rated quality of study (1) low (2) medium (3) high
	11	Comparability of groups (1) low (2) high
	12	Assignment of Ss to treatment (1) random (2) matched (3) covariance adjustment of intact groups (4) intact groups

CRITERION CHARACTERISTICS

Title of criterion measure used:_______________________________

Card	Column	Variable
	13-14	Content (1) Elementary science (2) General science (3) Biology (4) Life science (5) Earth science (6) Physical science (7) Chemistry (8) Physics (9) Other science (10) Combination of preceding (11) Non-science
	15-16	Type of criterion (1) cognitive level (e.g., Piaget) (2) knowledge (3) higher level skills - analysis, synthesis, and evaluation (4) understanding, comprehension (5) critical thinking (6) creativity (7) decision making

(8) science achievement (knowledge)
(9) affective level
(10) attitudes toward science class or instruction
(11) attitude toward method or system
(12) psychomotor/manipulative skills
(13) attitude toward science and the scientist
(14) questioning skills
(15) problem solving skills
(16) change in achievement
(17) science interest
(18) science background
(19) process skills
(20) science grades
(21) self concept
(22) application

17 Method of measurement
(1) published-national, broad gauged, standardized
(2) ad hoc written tests
(3) classroom evaluation (not including 1 and 2)
(4) observation (passive, unstructured)
(5) structured interview or assessment

18-21 Mean of criterion (on total N)
22-25 Variance of criterion (on total N)
26 Reliability of criterion (1) $r \leq .4$ (2) $.4 < r < .7$ (3) $r \geq .7$

PREDICTORS

Rated reliability (1) $r \leq .4$ (2) $.4 < r < .7$ (3) $r \geq .7$
Correlation of this predictor with criterion (-.26 coded -26) (+.38 coded 38)
NOTE: All correlations and deltas contain two digits to the right of the decimal. Signs are included in the raw data, but decimal points are not.

27 Sex: Reliability (ignore)
28-30 Correlation between sex and criterion

SEX EFFECT SIZE

31-34 $\Delta_m = \dfrac{\bar{X}_m - \bar{X}_f}{s_m}$ (sign in first space-numbers follow)

35-38 $\Delta_f = \dfrac{\bar{X}_m - \bar{X}_f}{s_f}$

39-42 Δ using pooled variance (m & f)
43-44 Source of effect size data
(1) directly from reported data or raw data (means and variances)
(2) reported with direct estimates (ANOVA, t, F)
(3) directly from frequencies reported on ordinal scale (Probit, x^2)

(4) backwards from variance of means with randomly assigned groups (v, etc.)
(5) nonparametrics (other than #3)
(6) guessed from independent sources (test manuals, other studies using same test, conventional wisdom)
(7) estimated from variance of gain scores (correlation guessing)
(8) p values - (find t value of p and work backward)
(9) reported with indirect estimates (ANCOVA)
(10) Pearson correlation
(11) biserial correlation
(12) point biserial
(13) Spearman's RHO
(14) calculated based on gains
(15) other
(16) more than one
(17) from calculated r values to t's and worked backwards

45-47	SAT scores (verbal) correlation
48-50	SAT scores (math) correlation
51	Age (grade level): Reliability
52-54	Correlation
55	Anxiety: Reliability*
56-58	Correlation
59	Arithmetic scores: Reliability*
60-62	Correlation
63	Attitude toward science: Reliability*
64-66	Correlation
67	Attitude toward school: Reliability*
68-70	Correlation
71	Cognitive level: Reliability*
72-74	Correlation
75	Environmental attitude: Reliability*
76-78	Correlation

CODING INFORMATION

Card	Column	Variable
3	1	Card Number (always "3")
	2-5	Study code
	6-9	Criterion code

SEX EFFECT SIZE

10	Environmental knowledge: Reliability*
11-13	Correlation
14	Handicaps: Reliability*
15-17	Correlation
18	Homework: Reliability
19-21	Correlation
22	Interest: Reliability*
23-25	Correlation
26	Internality: Reliability*
27-29	Correlation

30	IQ: Reliability*
31-33	Correlation
34	IQ (verbal): Reliability*
35-37	Correlation
38	IQ (nonverbal): Reliability*
39-41	Correlation
42	Language arts: Reliability*
43-45	Correlation
46	Math ability: Reliability*
47-49	Correlation
50	Motivation: Reliability*
51-53	Correlation
54	Number of science courses taken: Reliability
55-57	Correlation
58	Reading ability: Reliability*
59-61	Correlation
62	Achievement (grades): Reliability
63-65	Correlation
66	Achievement (tests): Reliability
67-69	Correlation
70	Science background: Reliability
71-73	Correlation
74	Self-concept: Reliability*
75-77	Correlation
78-79	Content of achievement predictors
	(1) Elementary science
	(2) General science
	(3) Biology
	(4) Life science
	(5) Earth science
	(6) Physical science
	(7) Chemistry
	(8) Physics
	(9) Other science
	(10) Combination of preceding sciences
	(11) Total GPA
	(12) Math (grades)
	(13) Language arts
	(14) Creative arts
	(15) Social studies
	(16) Academic performance on some test

(17) Knowledge
(18) Comprehension
(19) Application
(20) Higher Level Skills

CODING INFORMATION

Card	Column	Variable
4	1	Card Number (always "4")
	2-5	Study code
	6-9	Criterion code

SEX EFFECT SIZE

	10	SES: Reliability
	11-13	Correlation
	14	Spatial ability: Reliability*
	15-17	Correlation
	18	Study skill~~s~~: Reliability
	19-21	Correlation
	22	Race (white/black): Reliability
	23-25	Correlation

RACE EFFECT SIZE

Deltas computed for various pairings of races: white(W), black(b), Mexican(M), Non-Mexican Hispanic(N), Oriental(O), American Indian(A), other(OT)

	26-29	$\Delta = \frac{\bar{X}_W - \bar{X}_B}{s_W}$
	30-33	$\Delta = \frac{\bar{X}_W - \bar{X}_B}{s_B}$
	34-37	$\Delta = \frac{\bar{X}_W - \bar{X}_M}{s_W}$
	38-41	$\Delta = \frac{\bar{X}_W - \bar{X}_M}{s_M}$
	42-45	$\Delta = \frac{\bar{X}_W - \bar{X}_N}{s_W}$
	46-49	$\Delta = \frac{\bar{X}_W - \bar{X}_N}{s_N}$

50-53 $\Delta = \frac{\bar{X}_W - \bar{X}_O}{s_W}$

54-57 $\Delta = \frac{\bar{X}_W - \bar{X}_O}{s_O}$

58-61 $\Delta = \frac{\bar{X}_W - \bar{X}_A}{s_W}$

62-65 $\Delta = \frac{\bar{X}_W - \bar{X}_A}{s_A}$

66-69 $\Delta = \frac{\bar{X}_B - \bar{X}_M}{s_B}$

70-73 $\Delta = \frac{\bar{X}_B - \bar{X}_M}{s_M}$

74-77 $\Delta = \frac{\bar{X}_B - \bar{X}_N}{s_B}$

78-80 $\Delta = \frac{\bar{X}_B - \bar{X}_N}{s_N}$

CODING INFORMATION

Card	Column	Variable
5	1	Card Number (always "5")
	2-5	Study Code
	6-9	Criterion Code

RACE EFFECT SIZE

10-13 $\Delta = \frac{\bar{X}_{OT} - \bar{X}_A}{s_p}$ where s_p = pooled standard deviation estimate based on pooled variances of both races

14-17 $\Delta = \frac{\bar{X}_B - \bar{X}_O}{s_B}$

18-21 $\Delta = \frac{\bar{X}_B - \bar{X}_O}{s_O}$

22-25 $\Delta = \frac{\bar{X}_B - \bar{X}_A}{s_B}$

26-29 $\Delta = \frac{\bar{X}_B - \bar{X}_A}{s_A}$

30-33 $\Delta = \frac{\bar{X}_M - \bar{X}_N}{s_M}$

34-37 $\Delta = \frac{\bar{X}_M - \bar{X}_N}{s_N}$

38-41 $\Delta = \frac{\bar{X}_M - \bar{X}_O}{s_M}$

42-45 $\Delta = \frac{\bar{X}_M - \bar{X}_O}{s_O}$

46-49 $\Delta = \frac{\bar{X}_M - \bar{X}_A}{s_M}$

50-53 $\Delta = \frac{\bar{X}_M - \bar{X}_A}{s_A}$

54-57 $\Delta = \frac{\bar{X}_N - \bar{X}_O}{s_N}$

58-61 $\Delta = \frac{\bar{X}_N - \bar{X}_O}{s_O}$

62-65 $\Delta = \frac{\bar{X}_N - \bar{X}_A}{s_N}$

66-69 $\Delta = \frac{\bar{X}_N - \bar{X}_A}{s_A}$

70-73 $\Delta = \frac{\bar{X}_O - \bar{X}_A}{s_O}$

74-77 $\Delta = \frac{\bar{X}_O - \bar{X}_A}{s_A}$

CODING INFORMATION

Card	Column	Variable
6	1	Card Number (always "6")
	2-5	Study Code
	6-9	Criterion Code

RACE EFFECT SIZE

10-13 $\Delta = \frac{\bar{X}_W - \bar{X}_B}{s_p}$

14-16	Race (white/Mexican) correlation with criterion
17-20	$\Delta = \frac{\bar{X}_W - \bar{X}_M}{s_p}$
21-23	Race (white/Non-Mexican Hispanic) correlation with criterion
24-27	$\Delta = \frac{\bar{X}_W - \bar{X}_N}{s_p}$
28-30	Race (white/Oriental) correlation with criterion
31-34	$\Delta = \frac{\bar{X}_W - \bar{X}_O}{s_p}$
35-37	Race (white/American Indian)correlation with criterion
38-41	$\Delta = \frac{\bar{X}_W - \bar{X}_A}{s_p}$
42-44	Race (black/Mexican) correlation with criterion
45-48	$\Delta = \frac{\bar{X}_B - \bar{X}_M}{s_p}$
49-51	Race (black/Non-Mexican Hispanic) correlation with criterion
52-55	$\Delta = \frac{\bar{X}_B - \bar{X}_N}{s_p}$
56-58	Race (black/Oriental) correlation with criterion
59-62	$\Delta = \frac{\bar{X}_B - \bar{X}_O}{s_p}$
63-65	Race (black/American Indian) correlation with criterion
66-69	$\Delta = \frac{\bar{X}_B - \bar{X}_A}{s_p}$
70-72	Race (Mexican/Non-Mexican Hispanic) correlation with criterion
73-76	$\Delta = \frac{\bar{X}_M - \bar{X}_N}{s_p}$
77-79	Race (Mexican/Oriental) correlation with criterion

CODING INFORMATION

Card	Column	Variable
7	1	Card Number (always "7")
	2-5	Study Code
	6-9	Criterion Code
		RACE EFFECT SIZE
	10-13	$\Delta = \dfrac{\bar{X}_M - \bar{X}_O}{s_p}$
	14-16	Race (Mexican/American Indian) correlation with criterion
	17-20	$\Delta = \dfrac{\bar{X}_M - \bar{X}_A}{s_p}$
	21-23	Race (Non-Mexican Hispanic/Oriental) correlation with criterion
	24-27	$\Delta = \dfrac{\bar{X}_N - \bar{X}_O}{s_p}$
	28-30	Race (Non-Mexican Hispanic/American Indian) correlation with criterion
	31-34	$\Delta = \dfrac{\bar{X}_N - \bar{X}_A}{s_p}$
	35-37	Race (Oriental/American Indian) correlation with criterion
	38-41	$\Delta = \dfrac{\bar{X}_O - \bar{X}_A}{s_p}$
	42-44	Race (other/white) correlation with criterion
	45-48	$\Delta = \dfrac{\bar{X}_{OT} - \bar{X}_W}{s_p}$
	49-51	Race (other/black) correlation with criterion
	52-55	$\Delta = \dfrac{\bar{X}_{OT} - \bar{X}_B}{s_p}$
	56-58	Race (other/Mexican) correlation with criterion
	59-62	$\Delta = \dfrac{\bar{X}_{OT} - \bar{X}_M}{s_p}$

63-65	Race (other/Non-Mexican Hispanic) correlation with criterion
66-69	$\Delta = \frac{\bar{X}_{OT} - \bar{X}_{N}}{s_p}$
70-72	Race (other/Oriental) correlation with criterion
73-76	$\Delta = \frac{\bar{X}_{OT} - \bar{X}_{O}}{s_p}$
77-79	Race (other/American Indian) correlation with criterion

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Availability of Data

Copies of this manual and the data tape described herein are available from:

Laboratory for Research in Science and Mathematics Education
c/o Dr. Ronald D. Anderson
Campus Box 249
University of Colorado
Boulder, Colorado 80309

The cost of the manual, data tape, shipping, and handling is $50.00*

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